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WILLIAM WALLACE PAYNE.

By E. A. FATH.

William Wallace Payne was born at Somerset, Hillsdale County, Michigan, May 19, 1837, the son of Jesse D. Payne and Rebecca Ann (Palmer) Payne. As a boy he worked on the farm and attended the district schools of the times. He was greatly interested in arithmetic and even got a start in algebra. When he had gone as far as he could in the country schools he began his career as a teacher at the age of 17, teaching during the winter and helping his father on the farm in the summer.

At about the time he began to teach he attended the exercises in connection with the laying of the corner stone of a building for Hillsdale College. He saw here a group of young people attending college who greatly impressed him and the desire to be one of them became very strong. He found no way to satisfy the desire until, when he attained his majority, he felt free to leave home and strike out on his own responsibility. During this long wait he prepared himself for college as best he could.

His interest in astronomy was aroused when, as a boy, a copy of Smith's *Astronomy* came into his hands. This fascinated him.

He entered Hillsdale College in 1858 and was graduated in 1863 with the degree of A.B. He was obliged to defray his expenses by teaching occasionally in the district schools of the neighborhood and doing such odd jobs as could be found. This greatly interfered with his regular work at the college so that five years were required to finish his undergraduate course. In this interval he also spent one summer at Oberlin.

Two of his former teachers had gone into law and become successful lawyers. This turned his mind in that direction. He studied law at Ann Arbor and at the Chicago Law School, receiving the LL.B. degree from the latter institution in 1866.

His strenuous efforts at self-support in addition to carrying on his studies resulted in a break-down by the time he had finished his legal training. While recuperating he again took up teaching in the country schools and helping his father on the farm.

In 1868 he went to Mantorville, Minnesota, to practice law, associating himself with a former college friend, Robert Taylor. His heart, however, was not in the practice, and, when an opportunity came to take the place of a teacher incapacitated by illness, he went back to

teaching. Subsequently he became county superintendent of schools for Dodge county.

While at Mantorville he began the publication of the *Minnesota Teacher,* a periodical for the public school teachers of the state. He had become acquainted with the *Michigan Teachers' Magazine* while at Ann Arbor and saw the opportunity of establishing a similar publication for his adopted state.

In 1870 he was united in marriage with Josephine Vinecore of Stanton, Michigan, who, together with a daughter, Jessie V., survives him.

Carleton College had been founded in 1866 and in 1871 Professor Payne was called to the chair of Mathematics and Natural Philosophy. Later the title was changed to Mathematics and Astronomy.

His knowledge of astronomy at the time he took up his work at Carleton was very limited. He had had a short descriptive course at Hillsdale and a similar one during the summer at Oberlin. However, this meager training had aroused the desire to know more. While studying law at Ann Arbor he had met Watson who spent several hours showing him the observatory equipment there and telling of his asteroid work.

Shortly after coming to Carleton he determined to have an observatory. In order to understand the use of astronomical instruments before undertaking the observatory project, Professor Payne spent a summer vacation at the Cincinnati Observatory and worked under Professor Ormond Stone.

"In September, 1876, was taken the first step towards building an observatory. President Strong and Professor Payne, passing over a field of stubble, climbed a high board fence into a pasture not then owned by the college, and selected a site for the new observatory . . . Two years later the observatory was completed." It was equipped with a Howard clock, a Fauth 3-inch transit and an 8-inch Clark equatorial. The cost was defrayed by gifts from friends.

Time signals were first sent out by wire from the still uncompleted observatory October 23, 1877, and before long the railways having their principal offices in Minneapolis or St. Paul adopted them for their train service. Time balls were operated in the Twin Cities and adjacent regions. The demand for accurate time came from a wide region in Minnesota and farther west. Every effort was made to meet the demand. So successful was it that in 1881 General Hazen said it was the largest and probably most useful time service in the United States.

Meteorological observations were also begun, and, before long, the observatory became the center of the state meteorological observers. This continued until the Weather Bureau office was opened in St. Paul some years later.

About 1884 the desire to improve the time service led to the ordering of a 5-inch meridian circle (gift of J. J. Hill) from Repsold of Hamburg, delivery being promised in two years. The desire to house the

fine meridian circle in a building worthy of it led, in turn, to plans for a new observatory of brick and stone. The corner stone was laid in 1886 and the building was completed the following year. The plans included a 16-inch refractor. The dome was erected but remained empty until 1891 when Dr. E. H. Williams of Philadelphia made a gift of $15,000 for the long desired instrument. The lens was by Brashear and the mounting by Warner & Swasey. In the meantime the 8-inch Clark refractor had been transformed into a photographic instrument by the addition of a third lens and housed in a smaller dome.

The teaching of mathematics and astronomy in the college was carried on by Professor Payne with little help while he was getting the two observatories built and developing the time and meteorological services. Still he was not content. In 1882 he began the publication of the *Sidereal Messenger*, 10 numbers a year, and continued it until 1891 when, in collaboration with Professor Hale, he started *Astronomy and Astrophysics*. This publication, after the completion of three volumes, was taken over by Professor Hale and changed to the *Astrophysical Journal*. In the meantime Professor Payne developed POPULAR ASTRONOMY, the first number appearing in September, 1893. These publications were carried on by Professor Payne on his own responsibility until 1910 when POPULAR ASTRONOMY was purchased by the college.

Lack of space prevents telling of the many difficulties encountered in the building and equipping of the two observatories and in carrying on the publications and how these were overcome by the devotion and self-sacrifice of Professor Payne, and how he was encouraged and aided by Carleton's first president, Dr. J. W. Strong. These are described in part in Leonard's *History of Carleton College*.

In 1908 Professor Payne retire dfrom his work at the college but not to rest. He was asked by the Elgin Watch Company to establish a time service for their own use and went directly from Northfield to Elgin, planned the Elgin Observatory, and began the time service there. He continued in charge of this observatory until 1926 when he was in his 90th year at which time he was made director emeritus. He died January 29, 1928, at Elgin.

He received the honorary degree of Ph.D. from Hillsdale in 1894 and Sc.D. from Carleton in 1916.

Professor Payne was a tireless worker, always striving to improve his own work and expecting the same attitude on the part of his students. He was patient with those who he felt were making genuine efforts to advance but he had no use for those who did not take their work seriously. He conducted his classes by the recitation method. If his first question could not be answered by the first four or five students asked he would close the text, say: "Class dismissed. Same lesson tomorrow," and leave the room.

He was a deeply religious man. One could not be with him half an hour without feeling this. His belief in Divine Providence was so deep

and his faith so strong that it was reflected in his every act and word. He was active in church and Sunday school as well as in other religious activities. For many years he was a teacher in Sunday school and gave it up only in the last years of his life in Elgin.

Professor Payne himself never undertook any research work in astronomy. This is not to be wondered at since his duties as teacher and editor took up every moment of his time. However, he fully realized its value and when, on the completion of the second observatory, the staff was increased it was planned to undertake meridian work, micrometer observations with the 16-inch equatorial, and celestial photography. A start was made but the financial depression following in the country so affected the college finances that the staff had to be reduced and those remaining were obliged to carry a heavy teaching load.

His mind was not of the type which opens new paths, but, if once a suggestion or new idea came to him from any source, it was seized upon and not let go until he had given it careful consideration. He was ever alert to get new ideas or new points of view. This characteristic remained with him to the last. I saw him last in the summer of 1926 just after the Nantucket meeting of the American Astronomical Society. Although at the time rather feeble physically, he eagerly questioned me as to the character of the meeting and the papers presented.

He came to Carleton when it was a pioneer institution on the frontier. By his devoted service of nearly 40 years he aided his co-workers in developing a real college out of small beginnings. He left his impress on the lives of several thousand students; built two observatories, the second of which is one of the best college observatories in the country; organized an extensive time service for the Northwest; edited and published a series of astronomical publications which have been of real service to astronomy. Considering his almost negligible formal training in astronomy this activity is little short of marvelous. He was entrusted with less than one talent in this respect but he accomplished more than many a one with ten.

His was a great soul. He will long be remembered by his students and co-workers with respect and love.

THE TEACHING OF ASTRONOMY.

(Fifth Paper)

By DINSMORE ALTER.

A request that one write on this subject is a privilege and also a duty which must be approached with care. Too often we are in danger of believing that the methods which have met with individual success on our part are superior to others. It seems to the writer that, so long as the methods of teaching are confined within certain wide pedagogical limits, the personality of the teacher must be the determining factor in

the presentation of the subject. The methods outlined here are those which he has found successful; beyond that he is unwilling to endorse them. His only hope can be that some parts of them may be found useful by others, to be modified until they fall within the natural form of presentation by the user.

The few general principles which seem to him to be requisite of all science teaching are:

a. An emphasis on the scope and limitations of science and the changes in these limits; the methods of scientific advance; the uses of hypotheses, of experiment in testing hypotheses, and of experiment in suggesting new hypotheses; the interrelation of all sciences.

b. A study of methods of interesting the students.

c. A study of the uses to which students will put the information gained in the courses.

d. The use of as many of the five senses as possible in assisting the student's memory.

The following is merely a statement of how he has attempted to accomplish these four principles.

Few students who take an elementary course have any definite knowledge of what science is. The writer remembers serious misunderstandings on meanings of the terms, science, theory, hypothesis, and others, even at the end of his undergraduate study when he had completed quite a number of scientific courses. It seems to him that it is a matter of first importance that all educated men should have a clear idea of the meaning and applications of these terms. Anyone reading our magazines finds continually attacks on science and mis-statements regarding its content, which must serve to blur still more the minds of the readers and act to the detriment of the development of science through their financial, legislative, and religious reactions. If it were possible for each college student to know the fields which science claims for itself and why it claims these, to know the method of advance and of search for truth, to know the general fields in which science does not pretend to speak and why, we should, within a few years, find much less opposition and far more coöperation on the part of non-scientists. It is sad to note even presidents and deans of colleges making speeches and writing articles which show an entire lack of this elementary knowledge. The students of the elementary science classes are our main contact with those who will be successful in future non-scientific enterprises and who will, unfortunately in many cases, have a powerful influence over our work. A lecture, stating the extent of the scientific field in as elementary a way as possible and illustrated by many examples, seems to him one of the most useful ways of occupying an early session of these classes.

The students in our elementary classes may be grouped in three divisions. The largest of these is composed of those majoring in the arts and humanities; the next of those majoring in other sciences; and

the last of those who specialize in our own work.

Partly at the request of the head of the department of journalism, we have given here a two-hour course in descriptive astronomy. Its purpose in his mind was to give sufficient astronomical knowledge so that future reporters and editors should have at least enough knowledge of the subject not to be deceived by the grossest of mis-statements, and that they should be able to make a fairly correct report of an interview on the subject. This course does not require any laboratory work. The examination questions for both quizzes and finals are taken from a long series of mimeographed questions given to the student at the beginning of the course. Answers to almost all of these can be found in the textbook, thus permitting a greater lecture freedom than could be taken if the lecture were to be a drill on concrete facts, often dry and uninteresting. Perhaps a third of the questions are not taken up in class. Both students and the teacher have been pleased by the innovation which has been in force long enough for a thorough trial. Little of the subject matter of the new astrophysics can be undertaken, for these students are not ready for that. However, the better students are permitted to use it as a prerequisite to the five-hour class on the stellar universe to which the five-hour beginning course on the solar system naturally leads. This two-hour class has become so large that for several semesters two sections have been carried. The work is easier than in other astronomy classes but attempts are made continually to avoid its becoming a "cinch."

In this class, as in the other beginning classes, models are used continually. Few students have the natural ability or the training to visualize accurately from a blackboard diagram the relationships of three dimensional space. Most of these models already have been described in articles in POPULAR ASTRONOMY. Others have been devised and still others have been bought. The extensive use of these models is believed to be the most distinguishing feature of instruction here and the longer the writer uses them the more enthusiastic he is regarding their value.

Five of the windows of the lecture room are completely filled with the best lantern slides from our collection. Attention is called to them frequently during lectures and much use is made of them in addition to their projection through the stereopticon.

One night each semester the students are required to come to the observatory and are shown the most interesting objects through the telescope. One spring when the most interesting objects were in the morning sky, the hour was set at three. The novelty appealed to students and they were almost all enthusiastic over the meeting. Several wished that we had concluded the hour and a half of observation with a picnic breakfast at dawn!

The five-hour course on the solar system has been benefited by the introduction of the briefer course. Whereas there were formerly thirty

or more students taking this course, many of them totally unfitted for rigorous scientific study, there are now less than a dozen, but the quality has improved a hundred per cent. It is very seldom now that a weak student enrolls and those who really wish to get into the heart of the matter are not handicapped by retardation forced on the class by the slower students.

This course has three lectures and two two-hour laboratory periods. The type of work has been developed largely from that in the laboratory at the University of California. The engineer's transit is the basic instrument, and experiments are carried on with it of an accuracy far beyond that of the professional engineer. Among these may be mentioned a parallax experiment by which the parallax of a distant object is determined from the ends of a short, carefully measured base line; determination of latitude to five seconds of arc by observations of Polaris; circumference of the earth by having the class determine the latitude at another station about 25 miles away; the astronomical meridian, and time following the meridian experiment. Coördinate and descriptive experiments are given on the equatorial. Stormy afternoons and cloudy nights are devoted to globe experiments, plotting the positions of planets, etc. Graphical determinations of epochs of celestial phenomena are valuable and hold the students' interest at such periods.

The course on the Stellar Universe is handled much as the preceding one. The principal feature of the laboratory work is the making of series of photographs with the equatorial. A cheap and easily improvised ray filter is used and is made by the students. To make this, a lantern slide plate is fixed and washed, then dyed with potassium dichromate. The making of photographs, at various phases of the moon, interests the students who may have postcards made for their friends. It must be confessed that enrollment in this course is so small that it may become necessary to omit it from the curriculum.

Astronomy has done far more than other sciences in offering courses in history of science. In many universities not a single history of science course is given. Here we have attempted to develop the course almost to the point of a specialty. No other course can give such a thorough insight into the methods by which scientific research is carried on as does the history course. The logical chain of research from one individual and one generation to the other, the reasons for success and failure among the Chinese and the Greeks, the methods by which individuals have accomplished notable advances, all make a fascinating and romantic story that is certain to have much appeal.

In the history course we display a number of the older books, such as Copernicus, Tycho Brahe, Newton's *Principia* and others. Students enjoy looking at these and their value to the university has been large, despite the fact that little or no actual study is made in them.

The history course is the only one in which supplementary reading is required. Turner's *Astronomical Discovery*, Ball's *Great Astrono-*

mers, Lockyer's *Dawn of Astronomy,* Brashear's *Autobiography,* Newcomb's *Reminiscences of an Astronomer,* and other similar books add much to what the student obtains from regular history texts.

Another feature of this course is the semester paper which is a very thorough study of some particular subject. For graduate students these papers become quite elaborate treatises, often worthy of the dignity of being entitled research. Recently one such was a complete bibliography of all historical references found in the observatory library. When it is stated that our file of astronomical magazines is very complete, the fact that this bibliography ran into several hundred pages is easily understood. The paper has the different kinds of material segregated, and a very excellent index accompanies it. Bound, it becomes in manuscript form one of the valuable books of our library.

UNIVERSITY OF KANSAS, 1928 MARCH 14.

THE ORBITS OF THE COMETS OF SHORT PERIOD.

By WILLIAM H. PICKERING.

This paper is based on data recorded in Galle's *Verzeichniss der Elemente der Cometenbahnen,* on Crommelin's *Comet Catalogue* published in the *Memoirs of the British Astronomical Association,* **26**, part 2, on the *Reports on Comets* in the *Monthly Notices* for 1926, **86**, 221, and 1927, **87**, 296, which together include all the known cometary orbits through the year 1925. Many of the statistical data are here taken from my former paper in the *Harvard Annals,* **61**, 167, which, however, only went through the year 1900 and is thus also brought up to date, as far as the comets of short period are concerned. Much of what was then merely hypothetical is now corroborated by further data. That paper included 486 different cometary orbits, but of the total number 99, or 20 per cent, were returns of recognized comets, leaving 387 which were assumed to be different ones, and of these 20 were known to have returned at least once. Each of these comets and returns has received a separate number, which Crommelin's papers in the *Monthly Notices* have now brought up to 564.

These comets have been classified by two distinct methods, first, by their aphelion distances into Classes, lettered from A to H, and, second, into Types, based on the nearness of their aphelia to certain great circles of the sphere, and lettered from N to R. In general, comets of the same class belong to the same type, but this is not always so, especially for the comets of long period. In this paper we shall deal with the comets of class A type N, and with those of class B type O. Among the comets of the former class the shortest aphelion distance known is that of Encke's comet, 4.1 units, and the longest, that of number 348, 7.73 units. There are 41 different comets in this class. In

class *B* the shortest aphelion distance is that of number 213, 9.7 units, and the longest that of Grant, number 84, 59.1 units. This class contains only 19 different comets, but some of them, like Halley's and Tuttle's, have returned a number of times.

The comets of class *A* type *N* are associated with the planet Jupiter, and their aphelia with one exception all lie within a zone 20° in width, extending 10° on either side of the ecliptic. The exception is Schaumasse, number 498, whose aphelion lay in latitude —12°.2. It seems now, however, to be coming into line with the others, for at its next return in 1919 as number 535, its aphelion lay only 0°.5 outside of the zone, in latitude —10°.5. At its last return as 1927 *g* the latitude of its aphelion remained unchanged. It is perhaps a recent addition to type *N*, and not yet fully adjusted to it. Its orbit prior to 1911 when

TABLE I.

COMETS OF CLASS *A*.

First	Last	Long.	Lat.	No.	Name	Period	Dist.
117, 1786 I	553, 1924 III	338°.9	+ 1°.0	36	Encke	3.31	4.10
100, 1766 II	100, 1766 II	73.8	0.0	1	Helfenzrieder	3.89	4.53
311, 1873 II	557, 1925 III	126.9	+ 1.5	7	Tempel (2)	5.16	4.65
521, 1916 II	521, 1916 II	340.9	+ 2.5	1	Neujmin	5.41	4.82
293, 1867 II	336, 1879 III	58.8	— 3.4	3	Tempel (1)	5.98	4.83
358, 1884 II	358, 1884 II	126.5	+ 4.7	1	Barnard	5.40	4.87
451, 1902 II	545, 1922 I	30.4	+ 1.5	2	Grigg	5.02	4.97
368, 1866 IV	368, 1866 IV	50.6	— 0.7	1	Brooks	5.60	4.97
159, 1819 IV	159, 1819 IV	248.8	+ 1.6	1	Blanpain	5.10	5.02
113, 1783	113, 1783	233.0	+ 4.2	1	Pigott	5.88	5.06
396, 1890 VII	396, 1890 VII	238.0	— 2.9	1	Spitaler	6.37	5.06
404, 1892 III	469, 1906 III	165.1	— 5.0	3	Holmes	6.86	5.10
64, 1678	415, 1894 IV	165.4	+ 2.6	3	De Vico	5.86	5.11
529, 1918 III	529, 1918 III	217.1	+ 5.5	1	Schorr	6.73	5.21
300, 1869 III	481, 1908 II	223.8	— 5.0	4	Tempel (3)	5.68	5.22
554, 1925 I	554, 1925 I	265.7	+ 2.3	1	Wolf	7.50	5.24
520, 1916 I	520, 1916 I	288.7	+ 1.4	1	Taylor	6.37	5.30
85, 1743 I	85, 1743 I	275.5	— 0.2	1	Grischow	5.44	5.32
470, 1906 IV	532, 1919 I	103.1	— 2.9	2	Kopff	6.58	5.32
388, 1889 V	562, 1925 VIII	192.7	+ 1.5	4	Brooks	6.93	5.43
486, 1909 IV	486, 1909 IV	254.2	— 1.2	1	Daniel	6.48	5.57
158, 1819 III	542, 1921 III	88.6	— 3.9	10	Pons-Winnecke	6.04	5.60
359, 1884 III	563, 1925 IX	186.5	— 8.7	4	Wolf	8.28	5.60
210, 1846 III	334, 1879 I	294.7	— 7.2	5	Brorsen (1)	5.46	5.61
424, 1896 V	424, 1896 V	154.2	— 7.2	1	Giacobini	6.65	5.62
102, 1770 I	102, 1770 I	178.1	+ 1.1	1	Lexell	5.60	5.63
230, 1851 II	549, 1923 II	137.6	— 1.8	8	d'Arrest	6.63	5.71
406, 1892 V	406, 1892 V	198.5	— 5.0	1	Barnard	6.63	5.73
426, 1896 VII	485, 1909 III	229.5	— 3.5	2	Perrine	6.45	5.76
462, 1905 II	561, 1925 VII	250.1	+ 3.8	3	Borrelly	6.88	5.86
259, 1858 III	476, 1907 III	19.4	— 9.4	2	Tuttle (2)	6.61	5.89
200, 1843 III	588, 1925 IV	225.3	+ 3.6	9	Faye	7.32	5.97
447, 1900 III	508, 1913 V	188.4	— 4.3	2	Giacobini	6.51	6.00
371, 1886 VII	533, 1919 II	184.9	+ 2.2	4	Finlay	6.69	6.09
417, 1895 II	417, 1895 II	158.0	— 0.6	1	Swift	7.20	6.16
105, 1772	235, 1852 III	289.1	+ 8.6	6	Biela B	6.62	6.19
472, 1906 VI	472, 1906 VI	211.2	+ 4.2	1	Metcalf	7.77	6.22
412, 1894 I	412, 1894 I	310.6	— 4.0	1	Denning	7.42	6.48
498, 1911 VII	535, 1919 IV	315.4	—10.5	2	Schaumasse	8.07	6.87
389, 1889 VI	389, 1889 VI	220.1	— 9.6	1	Swift	8.92	7.24
348, 1881 V	348, 1881 V	198.9	+ 5.0	1	Denning	8.69	7.73

it was first recognized might be of interest, as well also as to what happens to it in the future.

In Table I, relating to these comets, the first column gives the designating number at the comet's first appearance, together with the year and yearly number. The second column refers similarly to its last appearance. The third and fourth give the longitude and latitude of its aphelion at this appearance, taken in most cases from the last computed orbit. The formulae for computing these quantities are not given in the textbooks. For the latitude we have

$$\sin B = -\sin \omega \sin i$$

and for L', the longitude from the node,

$$\tan L' = \tan \omega \cos i$$

L' is positive if i is less than 90°, and negative if i is greater. In the latter case we must be careful to take the supplement of the angle. The corrected longitude from the zero meridian is given by the formula

$$L = \Omega + L' - 0^{\circ}.014\,(t - 1900) \pm 180^{\circ}$$

The fifth column gives the number of the different observed apparitions of the comet, and the sixth the name of its discoverer, or in certain cases like Encke and De Vico of the name by which it is universally known. Since many comets of short period like those of long period have appeared only once, it is customary to designate such comets merely by their catalogue, or their yearly number. Only comets which have been recognized at a return are designated by the astronomer's name. Occasionally a second discoverer is also honored, and the name hyphenated. Three astronomers so far have discovered two or more comets which have returned, and the names in these cases are followed by an arabic numeral to distinguish them from one another. The last two columns give the period of revolution and the aphelion distance. The comets are arranged according to the figures in the last column, which, it will be noticed, differs materially from the order of their mean distances, as indicated by the previous column. The reason for this somewhat unusual arrangement is that the relation between the aphelion distances of these comets and the distances of the four major planets with which they are associated is clearly marked, while the relation between the planets and the mean distances, or periods of revolution, seems to be only secondary in its nature.

When the identity of two comets is suspected, one of which has been rather inadequately observed, a comparison of the location of their aphelia is a further and rather delicate test. Thus while there is a general resemblance between the elements of comets 259 Tuttle (2) and number 476, the resemblance is not striking. The longitude and latitude of the latter, of which few observations were secured, are given in Table I. Those of the former are 20°.0 and —8°.3, locating the aphelia of the two comets nearly within a degree of one another.

We will now divide all these various apparitions into five periods as shown in Table II, the first extending from 1678 when De Vico's, the first of Jupiter's comets, was discovered until 1826.0. The apparitions of the following one hundred years we will divide into four groups of twenty-five years each. If a known short period comet fails to appear in one of these groups, that is to say after three to four computed but invisible returns, we may consider it lost forever. There have hitherto been only two exceptions to this rule. The Pons-Winnecke comet, number 158, was first observed in 1819, just before the close of the first period. In the second period only five comets of class *A* were discovered, and Pons-Winnecke was not among them. It has been seen

TABLE II.

APPARITIONS OF THE COMETS OF CLASS *A*.

1678-1826.0		1826.0-1851.0		1851.0-1876.0		1876.0-1901.0		1901.0-1926.0	
No.	Name	No.	Name	No.	Name	No.	Name	No.	Name
64	De Vico	201	De Vico			415	De Vico		
85	—								
100	—								
102	—								
105	Biela	172	Biela	235	Biela				
113	—								
117	Encke	180	Encke	233	Encke	332	Encke	449	Encke
158	Pons-Win.			258	Pons-Win.	370	Pons-Win.	484	Pons-Win.
159	—								
		200	Faye	229	Faye	344	Faye	491	Faye
		210	Brorsen(1)	251	Brorsen(1)	334	Brorsen(1)		
				230	d'Arrest	328	d'Arrest	490	d'Arrest
				259	Tuttle(2)	476	Tuttle(2)		
				293	Tempel(1)	336	Tempel(1)		
				300	Tempel(3)	342	Tempel(3)	481	Tempel(3)
				311	Tempel(2)	333	Tempel(2)	460	Tempel(2)
						348	—		
						358	—		
						359	Wolf	500	Wolf
						368	—		
						332	Finlay	471	Finlay
						388	Brooks	457	Brooks
						389	—		
						396	—		
						404	Holmes	469	Holmes
						406	—		
						412	—		
						417	—		
						424	—		
						426	Perrine	485	Perrine
						447	Giacobini	508	Giacobini
								451	Grigg
								462	Borrelly
								470	Kopff
								472	Schaumasse
								486	—
								498	—
								520	—
								521	—
								529	—
								554	—

as a fairly bright object ever since, and doubtless would have been seen in the second period if it had been looked for carefully. De Vico's comet was missed in the third and also in the last period, and it is doubtful if it is seen again. Frequently the same comet has appeared several times in one or more of these periods. The number given it is then that of its first appearance in that period.

The number of comets of this class recorded in each of these five periods is 9, 5, 10, 25, and 22. The last two periods are as we see the only ones fairly comparable. We may note that no comet of class *A* has ever returned whose aphelion distance is greater than that of Schaumasse, 687. Its period by the last return is 8.07 years. Five out of the seven last comets in Table I have never returned. The two oldest comets of class *A* still extant are Encke, number 117, and Pons-Winnecke, number 158. These two have returned ever since 1786 and 1819 respectively. Faye's comet only was added in the second period, Biela's and Brorsen's having later been lost. D'Arrest and two discovered by Tempel were added in the third. Six more were added in the fourth, so that Jupiter now possesses twelve comets which have appeared with more or less regularity for over twenty-five years. Lately four other comets have been added to this named group, namely Grigg, Borrelly, Kopff, and Schaumasse. How permanent any of them will be, time only can determine, but they have each appeared at least twice. It will be seen by Table II that in the course of two revolutions Jupiter presents us with about two dozen comets, and of these about one-third will probably never be seen again.

It is now a well known fact that the orbits of several of Jupiter's comets are more nearly circular than those of a number of the asteroids, while their mean distances are similar. It was pointed out in 1910 that four comets were already known the eccentricity of whose orbits was less than 0.5. They were Holmes, number 469, $e = 0.412$, Tempel (1), number 336, $e = 0.463$, Brooks, number 396, $e = 0.470$, and number 396, $e = 0.473$. Several more have lately been added to this list. Three asteroids at least have higher eccentricities than these comets, namely Alinda, number 887, $e = 0.53$, Albert, number 719, $e = 0.54$, and Hidalgo, number 944, $e = 0.65$. This very last year a new comet was discovered, 1927 *j*, whose eccentricity according to the latest calculations is only 0.14. This places its orbit far within the asteroid group in this respect. While Jupiter is constantly adding to its family of comets by capture, it is also constantly losing them by the same process reversed. It is also losing some of them owing to their frequent visits to the Sun, by the repulsion and loss of the cometary gases by whose light we are alone able to see most of them. When these gases are finally expelled, the few comets which possess sufficiently large nuclei to be visible, and which move in orbits which are not too eccentric, will be indistinguishable in our telescopes from asteroids (*H.A.*, **61**, 303).

If such a comet were taken out of Jupiter's grasp by the simple

process of diminishing its orbital velocity, it would then become a permanent member of the asteroid group. This might have been done by one of the interior planets. If in past ages the Sun passed through a sufficiently extensive nebula, this very effect would undoubtedly have been produced. Geology by its various ice ages suggests a corroboration of this explanation. If Jupiter had added from its cometary family only one asteroid to the group in every 100,000 years, ever since the surface of our earth solidified, there would now be twenty times as many asteroids as are at present known to us.

The comets of class *B* type *O* are recorded in Table III, which is

TABLE III.

COMETS OF CLASS *B*.

First	Last	Long.	Lat.	No.	Name	Planet	Per.	Dist.
213, 1846 VI	213, 1846 VI	63°.4	+10°.2	1	Peters	Saturn	13.4	9.7
123, 1790 II	503, 1912 IV	285.8	+21.8	6	Tuttle(1)	Saturn	13.5	10.3
506, 1913 III	506, 1913 III	154.4	+ 3.5	1	Neujmin	Saturn	17.6	12.0
522, 1916 III	522, 1916 III	292.5	—76.0	1	Perrine	Saturn	16.4	12.4
27, 1366	290, 1866 I	240.5	— 2.7	2	Tempel(4)	Uranus	33.2	19.6
292, 1867 I	292, 1867 I	256.6	+ 0.8	1	Stephan	Uranus	40.1	21.8
178, 1827 II	178, 1827 II	124.4	—13.1	1	Pons-Gambart	Uranus	46.0	29.9
236, 1852 IV	509, 1913 VI	216.0	—33.3	2	Westphal	Neptune	61.7	30.0
356, 1883 II	356, 1883 II	285.4	—37.8	1	Ross	Neptune	64.6	31.9
220, 1847 V	534, 1919 III	261.6	—14.7	2	Brorsen(2)	Neptune	69.1	33.2
151, 1815	378, 1887 V	321.9	—39.6	2	Olbers	Neptune	72.6	33.6
148, 1812	357, 1884 I	259.8	+18.4	2	Pons	Neptune	71.6	33.7
211, 1846 IV	211, 1846 IV	259.4	—12.8	1	De Vico	Neptune	75.7	35.1
1A, —240	488, 1910 II	124.5	—16.6	23	Halley	Neptune	76.0	35.3
540, 1921 I	540, 1921 I	343.7	—22.2	1	Dubiago	Neptune	79.5	35.9
275, 1862 III	275, 1862 III	149.6	—24.8	1	Tuttle	?	119.9	47.6
386, 1889 III	386, 1889 III	147.2	—26.7	1	Barnard	?	128.4	49.8
524, 1917 I	524, 1917 I	33.1	—27.5	1	Mellish	?	145.0	55.0
84, 1742	475, 1907 II	20.9	+29.5	2	Grant	?	164.3	59.1

arranged precisely like Table I, excepting that the name of the associated and formerly controlling planet has been introduced in the seventh column. Owing to the small masses of these planets, the cometary aphelia are widely scattered over the celestial sphere, their zone extending from 30° north to 40° south of the ecliptic. There is only one exception to this rule to be found among them. The aphelion of number 522 lies far outside of this zone, in latitude —76°.0. The orbit is a little uncertain for lack of observations, although accepted by Crommelin. If it is approximately correct, this comet while belonging to class *B* must be included in type *Q*, a type whose zone includes the two poles of the ecliptic, although it is somewhat inclined to the latter circle. This as we shall see in a subsequent paper is quite explicable, although certainly surprising in a comet of so short a period, only 16.4 years. It should return in 1932 if the orbit is nearly correct, and a confirmation of such an unusual orbit would certainly be of great interest.

We see that there are at present 22 comets associated with Jupiter whose aphelion distances range from 4.10 for Encke to 6.87 for

Schaumasse. Similarly there are at least three associated with Saturn which range from 10.3 to 12.4. These planets for some unexplained reason do not seem to be able to retain their comets outside of a certain range. A very interesting comet has lately appeared, 1927 *f*, whose period according to Crommelin is 11.11 years (*M. N.*, 1927, **88**, 86). Its aphelion distance is 8.75 units, and it therefore lies between the two groups associated with Jupiter and with Saturn, but nearer the latter. Gale was the fortunate discoverer, but we think it very likely, unless its orbit is materially altered, that it will never be seen again. Uranus now possesses three comets whose aphelia range from 19.6 to 24.9 units, Neptune has eight ranging from 30.0 to 35.9, and there are four beyond, ranging from 47.6 to 59.1. These results are

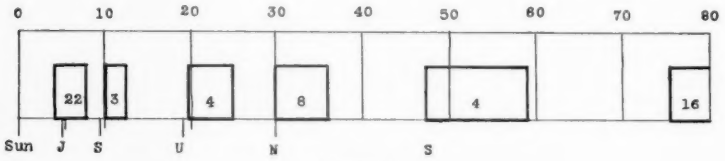


FIGURE 1.

APHELIA OF THE COMETS OF SHORT PERIOD.

plotted as a series of rectangles in Figure 1. The next cometary aphelion beyond them lies at a distance of 75.5 units as shown, making the largest gap in the whole cometary series. The only one of these gaps that has ever been even partially filled is that between rectangles J and S. Three attempts to fill it have already been made in the past, but in no case has the comet ever returned. Will the comet 1927 *f* be more persistent? Biela's comet, which was just on the edge of the gap as we know, disintegrated. Possibly that was the fate of the others. The short vertical lines at the bottom indicate the mean distances of the Sun and planets, and the very short lines, the aphelion distances. The rather unexpectedly large number of aphelia associated with Neptune is perhaps explained by the presence of planet *O*. The aphelia of the four comets further to the right would appear to indicate still another planet beyond, whose mean distance is in the vicinity of 48 units. As its period would then be 333 years, and that of its associated comets about half this figure, it is clear that we could have seen only a small portion of them, since a careful worldwide search for faint comets was inaugurated only about fifty years ago. At the same time their number does not imply a very large or massive planet,—one no larger than Neptune. This view is confirmed by the residual perturbations of Uranus. We believe that there is a larger planet still farther beyond, and after this and planet *O* have been found, and their perturbations allowed for, it will then be time for posterity to look for planet *S*.

Table IV is arranged for the comets of class *B* like Table II for those

TABLE IV.

APPARITIONS OF THE COMETS OF CLASS *B*.

—240-1826.0	1826.0-1851.0	1851.0-1876.0	1876.0-1901.0	1901.0-1926.0
No. Name	No. Name	No. Name	No. Name	No. Name
1A Halley	190 Halley			488 Halley
27 Tempel(4)		290 Tempel(4)		
84 Grant				475 Grant
123 Tuttle(1)		257 Tuttle(1)	307 Tuttle(1)	503 Tuttle(1)
148 Pons			357 Pons	
151 Olbers			378 Olbers	
	178 —			
	211 —			
	213 —			
	220 Brorsen(2)			534 Brorsen(2)
		236 Westphal		509 Westphal
		275 —		
		292 —		
			356 —	
			386 —	
				506 —
				522 —
				524 —
				540 —

of class *A*. Eight comets of this type have been seen more than once, and we find that their aphelia are on the average being drawn or driven slowly, perhaps by some unknown body, towards the south at the rate of 7′ per century. In several cases they have already passed out of the control of their associated planets. As a result of this gradual drive, the mean latitude of the aphelia of this type was found in 1909 to be —10°.0, or as far south as the southern limit of the zone of the comets of class *A*. Seven comets have appeared since then, and the mean latitude of their aphelia is —15°.6, or omitting the extraordinary orbit of number 522, it is —5°.5. The mean latitude for the whole group of 19 comets of class *B* is now —12°.0, and increases with the aphelion distance. This deviation from the ecliptic it would appear can hardly be accidental.

PRIVATE OBSERVATORY, MANDEVILLE, JAMAICA, B. W. I., MARCH 16, 1928.

HEAVENLY ZOO.

Draco.

This monster, killed by Hercules,
Watched apples of Hesperides
And now through northern heaven twines.
He owned the Pole in ages far:
His is the Greenwich zenith star:
Egyptian temples were his shrines.

Goat and Kids.

Beneath some sky, each night, these three
Of genus Capra Bovidae,
Shine, if no cloud their way besets.
The young appear triangular.
Capella is the great goat-star:
The trio are Auriga's pets.

1490 Stuart St., Denver, Colorado. LILIAN WHITE SPENCER.

OCCULTATIONS: A REPORT OF PROGRESS.

By ERNEST W. BROWN.

At the meeting of the American Association of Variable Star Observers at Cambridge last October, I gave a brief summary of the work done by members of the Association since the occultations were undertaken as part of their regular activities. In the meantime the occultations for the year 1926 have been finished as far as it is intended to go at the present time and a summary of the results was given at the Christmas meeting of the American Astronomical Society in New Haven. The details of the work and the results are to appear in the *Astronomical Journal*. Hence it is appropriate to give here, in addition to the matters reported at the Cambridge meeting, a more general account of the present status and of what has been done in the past.

The new tables of the motion of the moon came into operation at the beginning of 1923. The observatories at Greenwich and Washington continued their usual programs of taking meridian observations of the moon on all possible occasions. Unfortunately such observations suffer from many sources of systematic error and it is highly advisable to check up the results with occultations which are comparatively free from such errors. It is mainly owing to the activity of Dr. R. T. A. Innes, of the Union Observatory, at Johannesburg, that we now have a list of over 560 reduced occultations (immersions) with which to judge how the moon has followed the tables during the years 1923-26. Not only have he and his staff observed large numbers themselves, but they have also reduced their own and numerous occultations observed elsewhere. An almanac star can be reduced by an experienced computer in from one to two hours. But if the star has to be sought out in different catalogues and brought up to date the work is much increased. Dr. Innes has done this in many cases. Thus the confidence which the writer feels in the results deduced from the occultations during the past four years is due mainly to his work.

At the time when the writer was enlisting the services of the American Association of Variable Star Observers, Mr. L. J. Comrie had also recognized the importance of securing and reducing occultations. He enlisted the services of the British Astronomical Association for the same object. As matters have turned out, the work of the English has been mainly that of prediction while ours has been that of observation and reduction. An exception to this division must be mentioned. Mr. J. E. G. Yalden, the Chairman of the Committee on Occultations, has devised new methods for prediction and has used them, mainly for his own observatory at Leonia, N. J., and for Dr. Vouté's at Lembang, Java. The predictions are published where they are needed. For ex-

ample, a list for 1928 for California has just appeared in the *Publications of the Astronomical Society of the Pacific.*

It will be recalled that about a year ago an appeal was made for more observations of occultations. This was printed in various astronomical journals including POPULAR ASTRONOMY, and it is already evident that a generous response to this appeal is forthcoming in many parts of the world. As this appeal was made under the promise of coöperation by the American Association of Variable Star Observers, it is the more necessary that we do our part as completely as possible. On the whole, the progress has been satisfactory. Our contributors have been enthusiastic and have done excellent work and we anticipate more of it in the immediate future. The Association can, I think, look with some pride to its latest "infant industry" which will soon need no "protection."

Owing to various delays, the work on our side did not get into full operation before the summer. Suitable forms for reduction had to be made out and tried: these were drawn up by Mr. Yalden, the writer coöperating. They have now been printed from a Zincograph plate and are available on request with a mimeographed copy of instructions to those who wish to reduce their own observations. It always takes time to learn a new "stunt" and this kind of work was new to most of the members of the American Association of Variable Star Observers who have been assisting, but once understood it did not seem to present serious difficulties.

We have different kinds of coöperation. There are those who take care of the reductions of published observations. Others observe, and still others observe and reduce. One form of coöperation is growing and seems to be capable of considerable extension. Most of our universities and colleges have classes in Astronomy with advanced students in many cases. Since the chief part of the equipment necessary is to secure the time by radio or telegraph—a small telescope serves for observation—they are usually not put to any serious extra expense when occultations are undertaken. Both observation and reduction can be done by the students. In the latter, they learn how to get the apparent place of an almanac star, how to interpolate a position at a given moment from an ephemeris, how to change from sidereal to mean time and vice versa, and, most important of all, how necessary it is to be accurate in their work. Since the final result is a small difference, rarely exceeding 2″, of two numbers each about 1000″, any considerable error shows itself at once. Small errors are avoided by two independent computations. The work is published under the students' names. Vassar College was the first to undertake a regular program of this kind and the results can be seen in the files of the *Astronomical Journal.*

About a hundred occultations of the year 1926 have been reduced, the majority in duplicate. When it appeared that the requisite number was not available for a good determination of the year's mean, Mr. W.

J. Eckert, of Columbia University, and Mr. P. Slavenas and Dr. D. Brouwer, who are working at the Yale Observatory, made substantial contributions. Unfortunately some observers are not very careful about making and printing their observations: in two lists several errors were discovered, entailing much unnecessary computation because in general the errors cannot be found out until the work is practically completed. Then came a wind-fall of over eighty reduced occultations from Dr. Innes and there was a shorter list from Iljinsky, of Kiew. So that the only year from 1923 to 1926 for which the material is a little scanty is 1924. This is rather unfortunate because it seems that during this year the "mean error" started a drop which is still continuing, indicating a change at that time in the rate of rotation of the earth.

The work for the year 1927 has started well. Some good lists containing in all nearly sixty reduced occultations have already come in and others are expected soon. Now that 1926 is out of the way, the unreduced material for 1927 is being undertaken. Mr. Yalden has consented to replace the writer as "distributing and receiving agent" for the reduction of occultations by members of the American Association of Variable Star Observers—a change which became the more necessary owing to expected absence from New Haven until the end of July. A "sabbatical leave" starting with a couple of months in the mild climate of Pasadena and ending with the Congress at Leiden must not be allowed to interfere with the work and it is a great satisfaction to feel it is in such good hands. There is thus good hope that we can get the 1927 material in shape for discussion by next October when we have returned to our accustomed haunts.

CONCERNING THE IDENTIFICATION OF COMET SKJELLERUP-MARISTANY.

By MAUD W. MAKEMSON.*

Soon after comet Skjellerup-Maristany was discovered, elements were computed which made its identity with comet de Vico 1846 IV seem almost certain. Not only were the planes of the orbits similar, but the perihelion distance q was found to be the same, 0.6 of an astronomical unit. Later computations, based on observations extending over a longer period, have produced values for q between 0.3 and 0.14 A.U., and it is now definitely established that the true value lies below 0.2.

Under the direction of Professor Leuschner, an orbit determination for comet Skjellerup-Maristany was made at the Students' Observatory

*Research Assistant in Astronomy.

by Messrs. Mayall, Miles, and Whipple, all graduate students, while to me was given the opportunity of investigating the comet's identity.

Fortunately, the elements of comet de Vico were well determined by several noted astronomers, including Hind, Bond, Bren, Peirce, and von Hepperger, and the agreement between their independent computations leaves no doubt as to the orbit constants.

If the two comets are identical, the de Vico comet must have a period of 81.6 years instead of 75.6 years as given by the elements. Assuming an average daily motion (43".3874) to correspond with this period and using the elements by von Hepperger, I found that the orbit of comet de Vico could not be made to fit the observation of 1927 Dec. 19 unless the perihelion distance were reduced to one-third its original value. By taking q equal to 0.173—computed from the observations of Dec. 19-22—the mean motion as before, and the semi-major axis and eccentricity to correspond, and combining these with the constants to the equator for 1927.0 from the 1846 elements, I found that the observation of December 19 could be represented closely for a time of perihelion passage between December 17.0 and 18.0. This result merely states that the two comets are moving in the same plane, as is confirmed by the elements subsequently computed at the Students' Observatory and elsewhere.

The important thing was to try to ascertain what might have happened to comet de Vico during the 81.6 years to lengthen its period five years and to bring it closer to the sun at perihelion.

Two graphs, the first tracing the path taken by the de Vico comet in 1846 out to aphelion in 1884 and back to perihelion in 1921, the second following comet Skjellerup-Maristany back from 1927, imposing on it a period of 81.6 years, failed to reveal a close approach to a known planet.

As a check on this computation, I found the times when the hypothetical comet would have crossed the orbits of the major planets outward and inward bound. The results are tabulated here with the angular distance between comet and planet as seen from the sun:

Comet Crossed Orbit of	Radius Vector astron. units	Date	Difference in Heliocentric Long.
Jupiter	5	1846 Sept.	165°
Saturn	10	1848 Nov.	95
.....	15	1852 July	...
Uranus	20	1854 June	160
.....	25	1858 Nov.	...
(aphelion)	37	1887 Jan.	...
.....	25	1915 Mar.	...
Uranus	20	1919 Sept.	68
.....	15	1921 Aug.	...
Saturn	10	1925 April	42
Jupiter	5	1927 June	85

Figure 1 illustrates the path which the comet would have traveled between 1846 and 1927 and the relative positions of the major planets at dates corresponding to those in the table. Since the inclination of the

orbit to the plane of the ecliptic is approximately 80°, its projection on the planet orbits is here represented by a straight line. The line of nodes is so situated that only a small portion of the path is north of the ecliptic. The ascending node is close to perihelion.

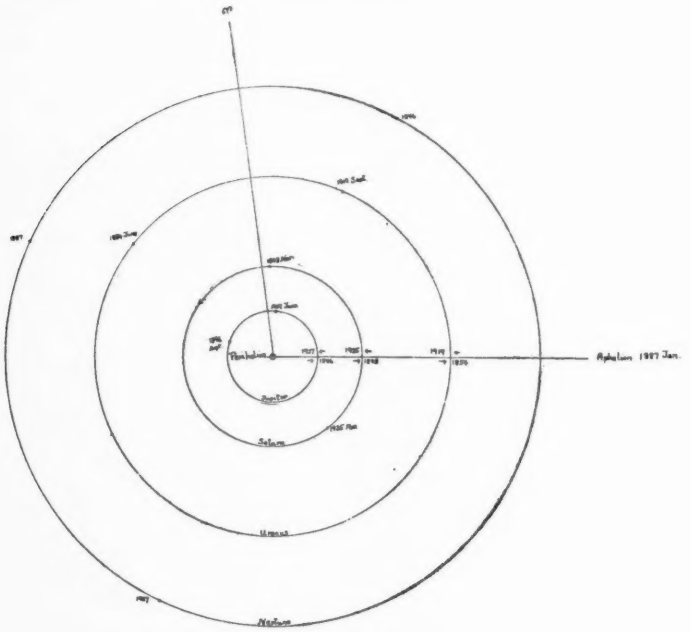


FIGURE 1.

Figure 2 shows the tremendous sweep of the comet's path about the sun. The heliocentric arc of 197°, covered in 26 days, was the basis for the widely-varying preliminary orbits derived at different observatories. The difficulty of computing an orbit for a rapidly moving comet was increased by inaccuracies of observation due to indefiniteness in the settings. The drawing of this object by Graff in *Astronomische Nachrichten,* **232**, No. 5549, illustrates this difficulty.

During the observed interval represented in this figure, the comet changed its heliocentric latitude from —70° to +70° approximately.

Neptune, which might have caused all the disturbance, was on the opposite side of the sun during the entire episode. Furthermore, there is very little circumstantial evidence that a trans-Neptunian planet is the disturbing body, since the comet only went about eight astronomical units beyond Neptune's orbit and was in latitude —12.8 degrees at aphelion.

One may then conclude only that the comets de Vico and Skjellerup-Maristany move in practically the same plane, which is inclined almost at right angles to the plane in which the planets move.

More interesting is the unanswered question: Why was not the de Vico comet observed if it returned to the sun in 1921?

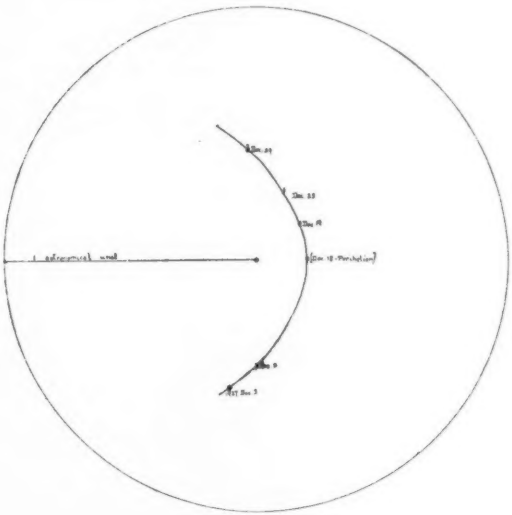


FIGURE 2.

Until more observations are obtained and the elements of the orbit of comet Skjellerup-Maristany are definitely known, speculation as to its identity may be postponed. At present, owing to the approximate nature of the observations, computers do not agree as to the perihelion distance or longitude, and even the inclination seems to be in doubt.

With definitive elements, it should be possible to trace backward the path along which the comet Skjellerup-Maristany made its swift flight into the central region of the solar system and find whether or not it intersects the orbit of de Vico's comet. For the present, the computer can only await further observations.

STUDENTS' OBSERVATORY, BERKELEY, CALIFORNIA.

Serpens.

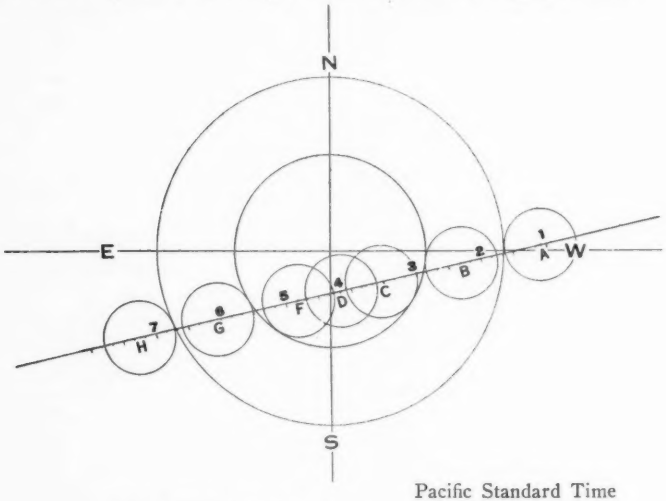
Outlined in stars against the night
Brave Ophiuchus holds him tight:
For reason, one is at a loss.
Between the Eagle and the Crown
His snaky length writhes up and down:
His head is called St. Andrew's Cross.

1490 Stuart St., Denver, Colorado. LILIAN WHITE SPENCER.

TOTAL LUNAR ECLIPSE JUNE 3, 1928.

By WM. CLETUS DOYLE.

This eclipse will occur before moonset only for the western states, and even they will be disappointed both by the fact that daylight will have begun and by the nearness of the moon to the horizon. West of the 105th meridian it will be possible to observe the time of the moon's entrance into the umbra and in some places the beginning of totality, and for southern California the end of totality. West of the United States to Asia, the whole eclipse will be an interesting spectacle.



		Pacific Standard Time
A	Moon enters Penumbra	1:05 A.M.
B	Moon enters Umbra	2:18
C	Totality begins	3:31
D	Middle of Eclipse	4:09
F	Totality ends	4:48
G	Moon leaves Umbra	6:02
H	Moon leaves Penumbra	7:15

The chart represents the penumbra by a large circle and the umbra by the smaller inner one. The course of the moon through the shadow can be followed along the oblique line on which are marked every ten minutes of time from 1:00 to 8:00 A.M. (Pacific Standard Time). After the moon enters the penumbra it gradually grows dimmer and dimmer until it touches the umbra; then a black shadow slowly spreads across its whole surface until at totality the moon becomes entirely invisible or glows with a dark colored light. Another total eclipse which will be visible all over the United States will occur next November 27.

CREIGHTON UNIVERSITY OBSERVATORY, OMAHA, NEBRASKA.

H. A. LORENTZ
1853-1928.

By A. VAN MAANEN.

The news of Lorentz's death on February 4, 1928, came as a severe shock to his numerous friends and admirers. It is true that he had reached an age at which the end may be expected at any time, but all who had seen him during the last few years felt that his three score and ten had not converted Lorentz into an old man.

On his last visit to this country, a year ago, he was as young as ever—a man who in spite of his age was not only able, but still eager to absorb and to impart to others the most modern developments in his field. For such a man the idea of age does not exist.

I do not think that any paper published by Lorentz in the more than fifty years of a most productive life bears a purely astronomical title. Yet an *in memoriam* to this outstanding physicist seems not out of place in an astronomical journal. Although there is hardly any branch of theoretical physics to which Lorentz has not contributed and although the whole development of physics in the last fifty years is so interwoven by the influence of this unique mind, we will recall only the three points which directly bear on astronomical problems and which are more than enough to claim him for our own branch of science; I mean his theory of the Zeeman-effect, which gave the explanation of the widening of the spectral lines in sunspots and the general magnetic field of the sun; the Lorentz-Fitzgerald contraction, which gave an explanation of the Michelson-Morley experiment, and above all the famous Lorentz-transformation, which became the corner-stone of the theory of relativity.

However, it is not alone as one of the most eminent physicists that Lorentz will be missed; his leadership in international affairs, culminating in his presidentship of the Committee of Intellectual Coöperation of the League of Nations has done much for the international understanding and appeasement. But most of all we will miss Lorentz for his qualities as man and as friend; for his generous helpfulness to three generations of scientific men; for his graceful simplicity and his unbounded kindness which have won the hearts of old and young who had the privilege of coming into contact with him.

His death leaves an emptiness in our lives; but in our memories he will live as one of the finest characters this world has ever produced.

Mount Wilson Observatory, April, 1928.

THIRTY-NINTH MEETING OF THE AMERICAN ASTRONOMICAL SOCIETY.

(Continued from page 241.)

ABSTRACTS OF PAPERS

THE TOTAL ECLIPSE OF THE SUN AT JOKKMOKK.

By W. J. Luyten.

A brief description was given of the expedition of the Hamburg Observatory, under the direction of Professor Schorr, to Jokkmokk, to observe the total eclipse of the sun on June 29, 1927. A few slides show some of the results, notably the extent and shape of the corona as photographed by Professor Schorr with the 20-meter camera, and of the flash spectrum photographed by Dr. Baade on a roll film.

A DETERMINATION OF THE DIAMETER OF THE MOON FROM PHOTOGRAPHS MADE AT THE TIME OF TOTAL SOLAR ECLIPSE.

By J. A. Miller and R. W. Marriott.

In this paper the writers present the results of the measures and reductions of three short-exposure photographs of the moon made at the 1926 total solar eclipse.

An attempt is made to determine whether or not the apparent diameter of the moon is affected by light from the eclipsed sun entering the shadow cone of the moon. The images of the moon were made with a long-focus camera (63 feet focal length). The plate constants and scale were determined from a starfield in Lepus impressed on one of the plates the night before the plate was exposed to the moon. The scale of the plates as determined from this starfield is:

$$1\text{ mm} = 10''.7107 \pm 0''.0002$$

The diameter of the moon, as determined from the measures of the three plates, and reduced to the center of the earth for the time of mid-exposure of plate No. 5, is $2001''.30 \pm 0''.18$.

The diameter of the moon as computed from Newcomb's and Brown's constants and the moon's horizontal parallax at the time of mid-exposure of plate No. 5 is $2001''.35$.

It is the belief of the writers that the method employed determines a good diameter of the moon, and that the apparent diameter of the moon is not affected in measurable amount by the light from the eclipsed sun entering the moon's shadow cone.

THE TOTAL ECLIPSE OF 1927.

By S. A. Mitchell.

A brief account was given of the program of the McCormick-Chaloner expedition. A summary was presented of the various parties both in England and in Scandinavia where clear or partly clear skies gave an opportunity for the securing of scientific results. At Giggleswick and at Jokkmokk in particular the sun appeared in a clear patch between heavy banks of clouds. Similar miracles of this fortunate kind have happened before at eclipse times to the parties from the Lick Observatory.

MAGNITUDES FROM TRANSIT CIRCLE OBSERVATIONS.

By H. R. Morgan and U. S. Lyons.

In observations of 10,000 intermediary and standard stars on the 9-inch transit circle of the U. S. Naval Observatory, 1913-1926, the magnitudes of all stars were reduced in observing to between the 9.0 and 9.5 magnitude by means of a screen system composed of two fine wire gauze screens and a cellular or variable screen devised by Professor F. B. Littell, for elimination of the magnitude equation.

The amount of screen used was recorded for each observation, and the magnitude-equivalent of the screen scale-reading was derived by comparing 20,000 such observations with the Harvard photometric magnitudes of the stars observed.

Using the scale-equivalent, so determined, the observed magnitudes of the catalog were derived. A correction for "seeing" varying with zenith distance, of the amount $0^{M}.20$ (sec $z - 1$), was found necessary in addition to the usual absorption. The probable error of a magnitude determined in this way is $\pm 0^{M}.2$.

In this way, recent magnitudes of 5,000 or 6,000 stars not in the photometric catalogs have been determined as a by-product of the regular transit circle work.

CLOCK RATES AND ROTATION OF THE EARTH.

By H. R. Morgan.

Data as to any possible variation of rotation of the earth depending on the moon's position have been deduced from observations with the 9-inch transit circle of the Naval Observatory in the period 1903-1921. The night rates of the standard clock as deduced from two clock corrections on the same night, one taken some four hours before midnight and the other one as much after midnight, have been compared with the standard average day-to-day rates. The differences of the two

rates on 1535 nights have been tabulated according to the hour angle of the moon as follows:

NIGHT RATE MINUS AVERAGE DAY-TO-DAY RATE.

Hour Angle of moon at midnight	No. nights	Excess hourly rate	Hour Angle of moon at midnight	No. nights	Excess hourly rate
0^h- 3^h	173	—0^s.00030	12^h-15^h	182	+0^s.00029
3 - 6	215	—0.00032	15 -18	213	+0.00054
6 - 9	195	—0.00042	18 -21	192	+0.00022
9 -12	194	—0.00045	21 -24	171	+0.00068

The hourly rate of the clock is 0^s.00037 less than the average, when the moon is west, and 0^s.00043 greater than the average, when the moon is east of the meridian. Theory calls for quantities of this size but with half the period.

FIREBALL OF FEBRUARY 27, 1927.

BY C. P. OLIVIER.

This brilliant fireball crossed part of North Carolina, moving approximately from west to east. It appeared at 9:00 P.M., E.S.T. These results are based on 15 reports. Its altitude of appearance was 76 miles, and of disappearance 19 miles; length of path 116 miles; azimuth of path 268°; relative velocity 17.5 miles per second. Hyperbolic direct motion was indicated, with $\iota = 1°.5$, $\pi = 142°$, and $q = 0.96$. It was yellowish-red in color and gave half the light of the full moon.

ON THE SPECTRA OF VERY LUMINOUS STARS.

BY CECILIA H. PAYNE.

Recent spectroscopic studies of the stars of Class O, and the work of Bowen in interpreting the nebular spectrum, have been used as the basis of a decimal classification of the spectra of the O stars and of the gaseous nebulae. The suggested classification is published in detail in *Harvard Bulletin* 855.

Data including central intensities, total absorptions, and contours of lines were presented for super-giant stars of spectral classes B0 to K0, and compared with the corresponding data for normal giants and dwarfs. Criteria of spectral class, of brightness, and of atmospheric structure may be selected from the spectrophotometric measures, which will shortly be published at Harvard.

THE ORBITS OF THE SPECTROSCOPIC COMPONENTS OF THE B-TYPE STAR HD 176853.

By J. A. Pearce.

The fifteen spectrograms, obtained, with one exception, during July and August, 1927, are well distributed in phase. The orbital elements were determined from eleven plates on which both components were measured. The principal results of the investigation are as follows:

1. The spectra contain the normal lines, of good quality, of the classes B5 and B8. The secondary has approximately one-fifth the intensity of the primary.

2. Separate solutions as well as a combined solution were made. The elements and their probable errors from the combined solution are: P (days) $= 1.849084 \pm 0.000055$; $e = 0.033 \pm 0.011$; $\omega_1 = 156°.16 \pm 11°.91$; $\omega_2 = 336°.16 \pm 11°.91$; $T =$ J. D. 2425074.648 ± 0.062; K_1 (km/sec) $= 150.58 \pm 1.84$; $K_2 = 241.18 \pm 2.63$; $\gamma = -12.86 \pm 1.26$; p. e. Br. ± 4.31; p. e. Fr. $= \pm 6.37$; $m_1 \sin^3 i = 7.1 \odot$; $m_2 \sin^3 i = 4.4 \odot$; $m_2/m_1 = 0.62$; $a \sin i = 9{,}956{,}000$ km.

3. The measures of the fainter spectrum were accordant and these were given half the weight of the primary measures. None of the residuals, either primary or secondary, exceeded three times the respective probable error, so that the inclusion of the secondary measures was justified, and the probable errors of the elements in the combined solution are not illusory.

GRAPHS FOR OBTAINING THE POSITION ANGLE AND DISTANCE OF THE APEX, AND THE GALACTIC COÖRDINATES FOR ANY STAR.

By J. A. Pearce and S. N. Hill.

The two recent determinations of the solar motion, that of W. W. Campbell and J. H. Moore from the radial velocities of 2119 stars and that of R. E. Wilson from the corrected proper motions of the Boss stars, agree closely with one another, their mean value assigning the apex of the sun's way, with respect to the naked-eye stars, to the point $\alpha = 271°$, $\delta = +28°$.

For this adopted value, two graphs have been constructed which give the position and distance of the apex for any star. The computations were carried out to the nearest minute of arc and the drawings made on the scale 10 degrees to the inch, so that the elements may be readily interpolated to the nearest half-degree, an accuracy more than sufficient for ordinary problems of stellar motions.

A third graph facilitates the conversion of equatorial coördinates into galactic coördinates.

The reproduced copies have the convenient scale of one millimeter to one degree.

SECOND NOTE ON PERSONAL EQUATION IN OBSERVING OCCULTATIONS.

By Edward C. Phillips.

This note sets forth a tabulated summary of all the numerical values published up to the present (as far as they are known to the author) of the personal equation for disappearance at the dark limb of the moon. The mean of the absolute personal equation for ten different observers using the chronograph for recording the moment of occultation was $-0^s.31$; for four observers using the eye and ear method it was $-0^s.03$, and for two observers using a stop-watch it was $-0^s.06$.

A NEW METHOD OF DETERMINING TEMPERATURES AND PRESSURES IN STELLAR ATMOSPHERES.

By Walter S. Adams and Henry Norris Russell.

On the assumptions that stellar atmospheres are in thermodynamic equilibrium, and that an atom at any level above the photosphere is equally effective in producing a dark spectral line, it follows that

$$\log N'_x/N_x = \log N'_0/N_0 + 5040E_x\,(1/T - 1/T').$$

Here N_x, N'_x represent the number of atoms in the atmosphere, above equal areas on the sun and the star, which are effective in the production of a given arc line; N_0, N'_0, the numbers of neutral atoms of the same element in the normal state; T, T' the atmospheric temperatures, and E_x the excitation potential for the line.

By the aid of the calibration of Rowland's scale, N_x and N'_x can be determined. By plotting $\log N'_x/N_x$ against E_x, values of $1/T - 1/T'$ have been found for a number of stars. The resulting photospheric temperatures are in good agreement with those determined in other ways, and range from about 3000° for α Orionis to 10,000° for Sirius. The values of N'_0/N_0 show that the atmospheres of the giant stars are much more extensive than the sun's. The quantity of metallic vapor above the same area is more than 100 times as great in α Orionis as in the sun. Procyon shows but little more than the sun; Sirius apparently less.

Enhanced lines, treated in the same way, give the relative abundance of ionized atoms. There is considerably more ionized metallic vapor above the photosphere in α Orionis than in the sun. At the star's low temperature, this indicates the existence of a very extensive chromo-

sphere—which is reasonable, since radiation pressure, compared with gravity, is much more effective in the star.

A CALIBRATION OF ROWLAND'S INTENSITY SCALE FOR SOLAR LINES.

By Henry Norris Russell, Walter S. Adams, and Charlotte E. Moore.

The relative numbers of atoms in the solar atmosphere which are engaged in the production of lines of different intensities on Rowland's scale may be determined by comparison of lines in the same multiplet, for which the theoretical ratios are known.

From 228 multiplets, including 1288 unblended lines of ten elements, the empirical formula was derived: $\log N = B \log A$. Here N is proportional to the number of atoms above a given area of the photosphere, B is a function of the wave-length, decreasing from 1.41 at λ3000 to 0.82 at λ6900, and $\log A$ depends on Rowland's estimated intensity, and runs from —1.80 for intensity 0000 to 4.17 for intensity 40. The zero point may differ in different spectral regions.

Comparison with observation shows that this calibration holds good for all elements that have been investigated, and that the probable error of $\log N$ derived from a single line is ± 0.32, corresponding to a probable error of ± 0.64 units in Rowland's intensity estimates.

The number of atoms involved in the production of such a solar line as Hα is about a million times as great as for the faintest perceptible lines.

ON THE SPECTROSCOPIC AND PHOTOMETRIC ORBIT OF RX HERCULIS.

By R. F. Sanford.

Twelve spectrograms of RX Herculis, obtained at Mt. Wilson near the phases of maximum separation of the lines, show that the orbital velocities are considerably greater than is indicated by Shapley's provisional orbit, and that the star eclipsed at principal minimum is the brighter and more massive of the two. A new solution from Shapley's light-curve, combined with new spectroscopic elements, indicates a circular orbit, with the following characteristics:

		Brighter star	Fainter star
Half-range of velocity	k	131 km/sec.	145 km/sec.
Radius of orbit	a	3,203,000 km	3,574,000 km
Radius (sun = 1)		1.95	1.76
Mass " "		2.08	1.86
Density " "		0.28	0.34
Inclination		86°.3	

If the surface temperature is taken as 10,000°, in accordance with the observed spectral type, the absolute magnitudes of the components,

computed from their diameters, are 1.42 and 1.65. Eddington's mass-luminosity law gives 1.56 and 1.95. The serious discordance with Eddington's theory, indicated by the provisional elements vanishes with more extensive data.

THE DISTRIBUTION OF LIGHT IN THE GLOBULAR CLUSTER ω CENTAURI.

By Jan Schilt.

The investigation is based on an out-of-focus photograph taken by Spencer Jones at the Cape with the Victoria telescope. The diameter of the individual star is 2 mm, and the central portion of the cluster is of a uniform grayness. Even in the center of the cluster the plate is not really black. It has been developed in ferro-oxalate so as to prevent the Eberhard effect. The surface intensity has been measured with the thermopile-photometer, whereby 3240 equally spaced settings are made, covering a square of 40x40 mm (1 mm = 30″). Settings were also made on a number of individual star images and the magnitudes of these stars have been derived from those of Bailey's comparison stars. The intensities have been compared with Bailey's star counts and whereas proportionality is found for the outer portion of the measured field, the counted numbers in the center are considerably below the number to be expected from the intensities. The measured intensities show a much larger increase of stellar density toward the center than the counted numbers. The total intensity is obtained from the sum of the measured fields and corrected for the intensity of the average star-light (outside the cluster) according to van Rhijn's results. The magnitude of the integrated light is $3^{M}.39$, and consequently this cluster is $3^{M}.73$ brighter than M3 of which the magnitude is $7^{M}.12$ according to Hertzsprung.*

A diagram of the measured intensities shows a very distinct elliptical structure. The major axis is in the direction 105° as found by Shapley from star counts.

The function $F(r)$, denoting the intensity of a strip whose center is at a distance r (seconds of arc) from the center of the cluster, has been compared with the same function as derived by Hertzsprung for M3. If the total absolute magnitudes are the same, I find from the difference in magnitude (3.73) a ratio of distance 1 : 5.6. The 5.6-fold enlargement of $F(r)$ for M3 is as closely a copy of $F(r)$ for ω Centauri as could be expected from the slight uncertainty in the scales of magnitude used. Independently of the total magnitudes, the relative $F(r)$ in terms of $F(o)$ (the intensity of the central strip), can be compared for the two clusters. In this way the ratio of the angular sizes is found to be 1 : 5.3. This means that if the linear sizes are the same, the ratio

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of the distances is 1 : 5.3. The internal mean error of the latter value is less than four per cent. The uncertainty in the difference of the total magnitudes is estimated to be $0^{M}.15$ (m.e.). The hypothesis that the median brightness of the variable stars is the same in the two clusters would give a ratio of distance 1 : 2.2.

If the absolute magnitudes are the same, then the linear sizes are the same and vice versa. In this case the absolute magnitudes of the variable stars at median brightness according to Bailey's results would be 1.5 magnitude fainter in ω Centauri than in M3.

SPECTRAL CLASSIFICATION AND THE HENRY DRAPER EXTENSION.

By Harlow Shapley.

The Henry Draper Extension deals mainly with stars fainter than the tenth photographic magnitude. The small dispersion necessary to photograph these faint spectra and to avoid overlapping in the rich Milky Way regions makes it impossible to attain greater refinement of classification than that already used in the Henry Draper Catalogue; moreover, the thirty or forty sub-classes in which the faint stars can be placed appear to be suitable and sufficient for the general statistical investigations of faint stars, for which the Extension is largely designed.

The necessity of standardizing the various spectral classes, of modifying some of the criteria, and especially of arranging interpretive sequences of two or more dimensions for the brighter stars, is recognized at the Harvard Observatory, and current investigations deal with modified classifications in Classes O, B, A, and M, (Miss Payne, Miss Williams, Hogg), with the variability of spectra (Miss Cannon, Miss Walton, Shapley), and with general surveys of the emission line problems (Gerasimovič) and of the peculiar problems of stars of high luminosity (Miss Payne). High luminosity stars are of special significance because they are the only ones attainable in the globular clusters, remote star clouds, and extra-galactic nebulae.

The progress of the work on faint stars and a comparison of the spectral classes at the north galactic pole with the color indices determined by Malmquist, using the exposure ratio method, will be discussed in forthcoming *Harvard Bulletins.*

THE ECLIPSING SYSTEM RS CANUM VENATICORUM.

By Bancroft Walker Sitterly.

From 1920 to 1922, 795 observations were made with the Princeton polarizing photometer on the eclipsing variable RS Canum Venaticorum (BD $+36°2344$). Through the courtesy of Director Shapley, 353

estimates of brightness made by Miss Woods, on Harvard plates taken from 1892 to 1922, were also made available. The Harvard measures with those of Hoffmeister, Nijland, and the writer gave the light-elements:

$$\text{J. D. } 2422811.666 + 4.797851\ E$$

where the epoch is in Greenwich Mean Time counted from *noon*.

The visual curve is somewhat asymmetrical. Not only is the descent into primary minimum steeper than the ascent, but between primary and secondary the system is $0^M.1$ brighter than between secondary and primary. Efforts to account for this asymmetry, by assuming the advancing side of the eclipsed star brighter, and by other hypotheses, have not been successful. Ellipticity and reflection, if present, are masked by other effects. The photographic curve does not show the asymmetry.

Solution of the visual curve gives very similar results, whether the asymmetry is allowed for or not. Adopted results are:

Depth of primary (total) $= 1^M.3$ of secondary $= 0^M.03$
Uniform $k = 0.3$ $\quad i = 79°.7$ $\quad r_b = 0.088$ $\quad r_f = 0.292$

The darkened solution demanded a secondary much deeper than that observed.

The photographic curve gave the results:

Depth of primary (total) $= 1^M.5$ secondary unobserved
Darkened $k = 0.3$ $\quad i = 78°.8$ $\quad r_b = 0.091$ $\quad r_f = 0.303$

The fainter star is redder than the brighter, and the brighter is possibly redder at the limb than at the center.

Dr. A. H. Joy has communicated to the writer, in advance of publication, spectroscopic elements of this system. These combined with the visual photometric results give absolute dimensions as follows:

Distance between stars:	12.8 million km.	
Radius of brighter	$= 1.12$ "	"
Radius of fainter	$= 3.73$ "	"
Spectra:	br. $=$ F4n	f. $=$ G8
Masses:	br. $= 1.88\odot$	f. $= 1.74\odot$
Densities:	br. $= 0.45\odot$	f. $= 0.011\odot$

Surface brightness of fainter, 1/25 of brighter.

The brighter star seems to be a fairly normal F dwarf, with a surface brightness a little low for its mass. But the other's combination of type, mass, density, and surface brightness is very unusual. It might perhaps be called a "sub-giant."

Further photometric studies of this system are desirable.

RECENT PHOTOGRAPHS OF THE PLANETS.

By E. C. Slipher.

Saturn, Jupiter, and Venus have been photographed with filters throughout a period of several months this year. For the most part filters transmitting red, yellow, and blue or visual violet were used. Two cameras have been used with the 24-inch refractor, one adapted for photographing in yellow or red light while the other is arranged to secure, in combination with the spectrographic correcting lens, blue or violet photographs, so as to secure two almost simultaneous series.

The cameras were set to magnify about 175 for the blue and red photographs and about 215 times for the yellow ones. For the most part Ilford Process Panchromatic plates were used for the red photographs, Cramer's Iso-Medium for yellow, and lantern-slide emulsions for blue and violet. Chiefly Tri-red filters were used for the red, a Wallace D screen for the yellow and Wratten No. 34 or Corex Blue-Purple U-V glass for the blue and violet images.

Saturn. The photographs of Saturn show that the ball is much darker, as compared to the rings, in the violet images than in the yellow or red ones and that the ball is relatively brighter in the red than in the yellow images. The blue-violet photographs show the ball as a whole much darker this year than it was in 1926. This is especially true of the south polar region. The dark sash across the equator, too, appears more intense than last year.

Jupiter. The photographs of the region of the Great Red Spot show the striking change in the south tropical zone, which became bright in early June, 1926, and has remained so since. The blue images display the south tropical belt as much brighter than the equatorial bright belt. Visually they are much alike. The Red Spot, which has appeared distinctly reddish since June, 1926, stands out very prominently in blue photographs. In red photographs only a trace of it is visible.

A photograph of Jupiter by blue light on November 26, 1927, shows a peculiar darkening of a large segment of the planet on the phase side.

On photographs taken a few minutes apart on October 9, 1927, it is remarkable how much alike the belts appear in the blue and the red, showing little effect of the planet's atmosphere.

Photographs made September 20, 1927, from blue light, show a distinct fading of the belts from center to edge of the disk. The broad north tropical belt becomes strikingly faint at the margins of the disk. The other belts also seem to share in this fading. This fading is apparently produced by overlying atmosphere.

Venus. There appears to be no appreciable difference in the diameter of violet and red images of Venus such as occurs in photographs of Mars and Jupiter.

Blue-violet photographs of Venus, taken on different dates, display

bright and dark areas, presumably of the same character as those announced by Dr. Ross, and show that these spots vary from day to day. These markings increase in conspicuousness with decrease of phase. They also appear more commonly on the limb side of the disk rather than, as one might expect, along the terminator.

It appears that on Jupiter we have observed features of atmospheric character. The chief differences between the red and the violet photographs, on the other hand, seem largely accounted for by color differences of the disk. The fact that the belts show about equally well in blue and red light hints that the amount of the planet's atmosphere lying above the belts is relatively small. The belts apparently lie high in the planet's atmosphere and all at about the same general level. Since the belts do not vary appreciably during the Jovian day, it appears that the energy that gives rise to them is Jovian and not solar.

What has been remarked of the surface phenomena on Jupiter seems true also of Saturn.

What we observe on Venus is even more in question, but radiometric measures and photography in violet light appear to be means of increasing our knowledge of conditions on her surface.

DAYLIGHT OBSERVATIONS OF SKJELLERUP'S COMET AT THE LOWELL OBSERVATORY.

By V. M. Slipher and E. C. Slipher.

Visual, photographic, spectrographic, and radiometric observations of Skjellerup's Comet (1927 *k*) were secured on December 16-19 under good conditions of transparency although the seeing was generally unsteady.

On the evening of December 15, Mr. E. W. Slade reported an object closely following the sun as it set. Mr. E. C. Slipher, the next morning, found the comet to be an easy object to the naked eye. The experienced observer saw it readily during that day by merely extending the hand to shadow the eyes from the sun, which was only about five degrees southwest of the comet. Venus, to the west of the comet, was available for comparison. Early in the day of December 16, the comet was many times the brightness of Venus, and relatively a conspicuous object by reason of its brightness and tail.

The nucleus was of an orange yellow color and small but not quite stellar in form or sharpness. At times it appeared distinctly elongated. The nucleus was enveloped by the arching hoods commonly seen of bright comets. The tail was broad and about 45′ long. One could not avoid thinking of the splendid display the comet would have made if it could have been seen against a night sky.

By early afternoon (December 16) the comet had faded and the tail had also changed in appearance. Some photographic images of the

comet were secured by E. C. Slipher during the middle of the day, December 16. Obviously, photographing a comet against the mid-day sky and only five degrees from the sun required unusual methods. Such a case evidently called for photography in red light. A 6-inch aperture lens of 90 inches focus was used, and the exposures were very short. A drawing of the comet, also, was made at the large finder of the 24-inch refractor.

After Saturday, December 17, the comet was seen (during the day) only with the aid of the telescope. It was last observed in the late afternoon of December 19. Attempts to direct the telescope on it the next day, December 20, in full day light were unsuccessful.

It was with eager interest that the comet's spectrum was first examined visually on the morning of December 16. However, it showed—on the sky-spectrum background—only a strong continuous spectrum of the nucleus, of the solar type. This meant that the central portion, at least, was illuminated by reflected sunlight. Examination with both low and high dispersion then showed the same result, disclosing none of the usual cometary bright bands. The next day, it was seen that the dark [D] lines of sodium of the sky spectrum were bordered with faint bright [D] lines of the comet. And on December 18, these had strengthened until they were a very conspicuous pair of bright lines superposed upon the solar (sky) spectrum. The following day they were still brighter. They were long and very considerably displaced to the red side of their normal position, proving the comet was rapidly receding from the earth. The emitting sodium spread to a considerable distance from the nucleus, and was most intense on December 19, the last day of observation. These lines were very sharp in the comet, more so than in the comparison spark. The two lines were quite closely of equal strength in the comet, but [D_1] was very much the weaker in the spark comparison spectrum. The shift of the lines, December 19, amounted to about 60 miles per second.

Although looked for, no trace was found, visually or photographically, of the usual cometary bright bands. The long series of spectrograms included the spectrum region of two of these bands—λ 5165 and λ 5635—the former of these perhaps the most capable of the series to show itself under the conditions. These observations indicate that, at least for this period of observation, the comet, except for sodium rays, shone by reflected sunlight alone.

The radiometric measurements, the first ones yet to be obtained of a comet, are treated elsewhere by Mr. C. O. Lampland.

THE DISTRIBUTION OF THE PERIASTRA OF SPECTROSCOPIC BINARIES.

By Paul Slavenas.

The *Third Catalogue of Spectroscopic Binary Stars* was used to obtain the distribution of periastra. The stars denoted as Cepheids were disregarded. The number of stars for each ten degrees in π was counted, and the arithmetical means of every two successive intervals were plotted against π.

The characteristic features of the distribution are four prominent peaks corresponding to about 20°, 120°, 190°, and 260°. Moreover, there is present some concentration of the binaries in the first and second quadrants, discovered first by Miller Barr in 1908, and discussed by various authors: the quantity

$$\lambda = \frac{N_{0-180} - N_{180-360}}{N_{0-180} + N_{180-360}},$$

which may be regarded as the measure of this effect, being of the order of 0.1. This value is too large to be explained as a mere accident.

Supposing that the results might be vitiated by Cepheids—or by other "pseudo-binaries"—the author discussed separately all the systems possessing a mass function less than 0.01. The quantity λ for these objects appeared to be the same as for all the binaries, namely 0.1.

In order to account for this inequality, the effect of unequal brightness of two hemispheres of the brighter component was discussed. The resulting irregularity in the radial velocity was computed on some rough assumptions. It was shown that, as a consequence, the computed periastron will be shifted toward 90° as compared with the real periastron. Under some favorable conditions an average difference of fifty per cent in brightness between two stellar hemispheres, for the systems possessing small eccentricities, may account for the value of $\lambda = 0.1$.

THE EFFECT OF ATMOSPHERIC DISPERSION UPON THE DETERMINATION OF STELLAR PARALLAXES.

By Frederick Slocum and C. L. Stearns.

For stellar parallax work with the 20-inch visual refractor of the Van Vleck Observatory a "Minus Blue" filter and Cramer Instantaneous Iso plates are used. With this combination an attempt was made to measure the relative shift in position of the "Trapezium" stars of θ_1 Orionis, of type Oe5, with respect to four comparison stars of types F and G.

Two ten-minute exposures were put upon each plate. The rotating sector was used to reduce the "Trapezium" stars about three magni-

tudes. The mean of the diameters of their images is then nearly equal to that of the comparison stars, weighted according to their dependences.

Thirty-three plates were taken, seventeen with a mean hour-angle $2^h\,28^m$ east and sixteen with a mean hour-angle $2^h\,51^m$ west. These were all taken within a few weeks during the winter of 1927, so that there are probably no appreciable effects of proper motion or parallax. The plates were measured and reduced to a standard by the "Dependence" method as in parallax work. The residual or plate solution, (m), was assumed to be the effect of atmospheric dispersion plus a constant.

If we let $R = \beta \tan z$ be the refraction in zenith distance of the comparison stars and $R' = (\beta + \Delta\beta) \tan z$ the refraction of the "Trapezium" stars, then $R' - R = \Delta\beta \tan z$, where $\Delta\beta$ is the dispersion coefficient at altitude 45°. The component parallel to the equator will be $\Delta\beta \cos\phi \sin t \sec z$ where ϕ is the latitude, t the hour-angle and z the zenith distance. Let $a = \sin t \sec z$ and $x = \Delta\beta \cos\phi$, then each plate will give an equation of the form $ax + y = m$. A least square solution gives x, and $\Delta\beta = x/\cos\phi$.

TABLE I.

	X mm	Y mm	Dependences	Diam. mm	Spec.	Mag. vis.	Color index
No. 1	—49.7	+23.8	.154	.138	F8	9.9	+0.5
2	—43.9	—41.5	.307	.177	F5	9.5	+0.4
3	+38.3	+39.3	.193	.159	G0	9.1	+0.5
4	+55.2	—21.6	.346	.066	F?	10.5	+0.4?
				.135			
θ_1 1	+5.03	— 8.9		.142	Oe5	6.84	—0.4?
2	+5.22	— 8.6		.080	Oe5	7.93	—0.4?
3	+5.43	— 9.3		.204	Oe5	5.36	—0.4?
4	+5.91	— 9.0		.146	Oe5	6.85	—0.4?
				.143			

Table I gives data for the comparison stars and the "Trapezium" stars.

TABLE II.

		Diam.	ΔD
θ_1 1	$\Delta\beta = -''.015 \pm ''.009$	.142 mm	+ .007 mm
2	$= -.010 \pm .009$	.080	— .055
3	$= +.002 \pm .011$	.204	+ .069
4	$= -.012 \pm .009$	.146	+ .011
Mean	$\Delta\beta = -''.010 \pm ''.005$		

Table II gives the dispersion results for the "Trapezium" stars referred to the F and G-type comparison stars. ΔD is the difference in diameter between the individual stars and the mean of the comparison stars.

The results from Nos. 1, 2, and 4 agree well in spite of the fact that $\Delta\beta$ is practically of the same order as the probable errors. The dis-

crepancy in No. 3 may be a guiding error due to its large diameter. Since refraction is greater for a blue star than for a yellow one, $\Delta\beta$ should be positive, if our assumption as to the color indices of the "Trapezium" stars is correct. The minus sign may mean that the O-type stars, shining through nebulosity, are actually redder than the F and G comparison stars, or, what seems more reasonable, that the dispersion effects in the case of a visual refractor, color filter and Iso plate are less than the errors of observation, and so, inappreciable in parallax determinations.

For other recent work along this line see Schlesinger, *A.J.*, **36**, 169; Slocum, *Ap.J.*, **59**, 108; Hudson, *Pub. Allegheny Obs.*, **6**, No. 2; Davidson and Greaves, *M.N.*, **83**, 56.

(To be continued.)

PLANET NOTES FOR JUNE.

By CLIFFORD E. SMITH.

The *Sun* will be moving northeast until the occurrence of the summer solstice on June 21. After that date the sun will be moving southeast. The summer solstice marks the beginning of summer. During the first part of the month the sun will be in the eastern part of Taurus, and during the last part of the month it will be in the western part of Gemini. On June 17 there will be a partial eclipse of the sun. It will be of little interest, however, since only about four one-hundredths of the disc of the sun will be hidden at the time of greatest eclipse. This partial eclipse will be invisible at Washington. The position of the sun on June 1 and June 30 will be respectively: R.A. $4^h\ 34^m$, Decl. 22° 0′; and R.A. $6^h\ 35^m$, Decl. 23° 13′.

The phases of the *Moon* will occur as follows:

Full Moon	June	3 at	6 A.M.	C.S.T.
Last Quarter		10 "	12 P.M.	"
New Moon		17 "	3 P.M.	"
First Quarter		24 "	5 P.M.	"

The moon will be at apogee (farthest from the earth) on June 1 and June 28, and it will be at perigee (nearest the earth) on June 16.

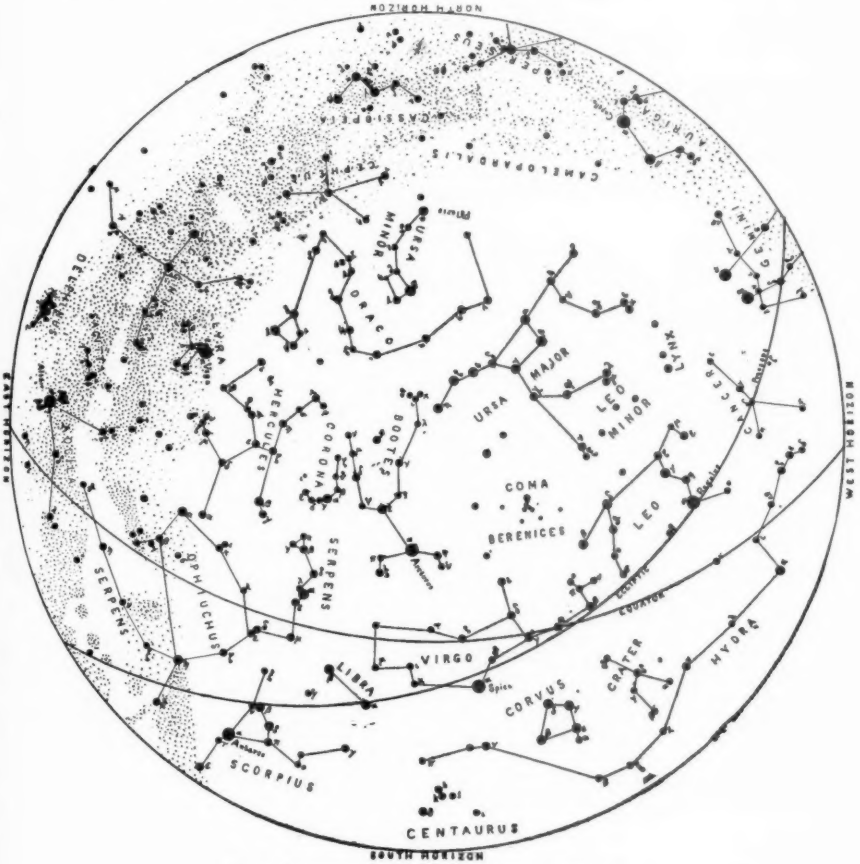
Mercury will be in the western part of Gemini. On June 3 it will be at greatest elongation east of the sun and at that time it will set about an hour and a half after the sun. On June 29 Mercury will be at inferior conjunction. On the same day it will be in conjunction with Venus also.

Venus will be approaching superior conjunction so that its apparent position will be near that of the sun. On June 29 it will be in conjunction with Mercury, and on July 1 it will be at superior conjunction.

Mars will be in Pisces most of the month. Late in the month, however, it

will cross into Aries and be near Jupiter. During the middle of the month it will rise about four hours before the sun.

Jupiter will be in the southern part of Aries, and during the middle of the month it will rise about three and a half hours before the sun.



THE CONSTELLATIONS AT 9:00 P.M. JUNE 1.

Saturn will be in the southern part of Ophiuchus. On June 6 it will be in opposition with the sun. Thus the first part of the month it will be near the meridian at midnight.

Uranus will be in the central part of Pisces. On June 29 it will be in quadrature west of the sun so that during the latter part of the month it will be near the meridian at sunrise.

Neptune will continue to be near Regulus in Leo. During the middle of the month it will set about 10:30 P.M. Standard Time.

Occultations Visible at Washington.

[From the *American Ephemeris.*]

Date 1928	Star's Name	Magnitude	IMMERSION. Washington C.T.	IMMERSION. Angle from N	EMERSION. Washington C.T.	EMERSION. Angle from N	Duration
			h m	°	h m	°	h m
June 3	θ Ophiuchi	3.3	21 18	158	22 11	243	0 52
10	69 Aquarii	5.6	0 23	14	0 58	308	0 35

VARIABLE STARS.

ϵ Aurigae.—This variable star, with a period of 27.1 years and a duration of minimum of nearly two years, was predicted to enter the eclipsing phase about June 1, 1928. Photo-electric observations at Madison were begun in January in order to establish the magnitude outside of eclipse. The measures were taken every two weeks or so in a routine manner with no special attention, until on March 10 we suddenly noticed that the star had been growing fainter at the rate of 0.08 magnitude per month. This change was announced in *Harvard Announcement Card* No. 61, and was confirmed by McLaughlin who had been following the star with both photometer and spectrograph at Ann Arbor. In *Harvard Card* No. 63 Director R. H. Curtiss called attention to McLaughlin's spectroscopic measures which indicate that ϵ Aurigae is a triple system, there being also a companion with a period of 150 days. The eclipse of this double system by the distant companion may be expected to show complications, especially if the close companion gives enough light to be detected. After this suggestion had come from Ann Arbor, our very next measure on March 30 showed that the light of the system had begun to increase, and since then up to April 19 the brightening has continued steadily.

As no announcement of the variability of ϵ Aurigae during maximum light had come to our attention, it was natural to suppose that the present changes had to do with beginning of the main eclipse, but in *Astronomische Nachrichten* Nr. 5555, just received, Frl. Güssow gives a series of photo-electric measures from Berlin-Babelsberg, extending over the last year and a half, which shows that the star has been variable to the extent of one or two tenths of a magnitude. No law for this small variation has been found, and if it turns out to be quite irregular the determination of the elements of the eclipsing system will be only approximate.

In the following table of results secured at Madison, the plus sign indicates that ϵ Aurigae with shade glass was fainter than the mean of three comparison stars, 5 Aurigae, λ Aurigae, and H.R. 1668.

	Difference in Magnitude
1928 January 20	$0^M.00$
22	+ .01
February 1	+ .07
20	+ .10
March 4	+ .13
14	+ .16
30	+ .08
April 9	+ .03
12	+ .03
19	— .02

The star is now getting low in the west and can not be followed for accurate observation much after the first of May. It will then be out of reach for a couple of months, and we shall miss entirely the predicted beginning of

minimum in June. However, since from Schmidt's observations of 1874 to 1876 Lundendorff found that the decrease in light lasted some six months, there will be opportunity to observe further changes later in the summer.

Madison, Wisconsin, April 21, 1928.

JOEL STEBBINS.
C. M. HUFFER.

Minima of Variable Stars of Short Period.

[Calculated by members of the classes in Astronomy at Carleton College.]

Given to the nearest hour in Greenwich civil time; to obtain Eastern Standard time subtract 5^h; Central Standard time 6^h, etc.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of Minima in 1928 June							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
SY Androm.	0 08.0	+43 09	9.5—13.0	34 21.8								
RT Sculptor.	31.5	—26 13	9.6—10.5	0 12.3	5 17	12 21	20 1	27 4				
U Cephei	0 53.4	+81 20	7.0— 9.0	2 11.8	5 21	13 9	20 21	28 8				
Z Persei	2 33.7	+41 46	9.4—12	3 01.4	1 13	7 16	19 21	26 0				
TW Cassiop.	37.6	+65 19	8.2— 9.0	1 10.3	3 18	9 11	20 21	26 14				
RY Persei	39.0	+47 43	8.0—10.3	6 20.7	5 9	12 5	19 2	25 23				
RZ Cassiop.	39.9	+69 13	6.9— 8.1	1 04.7	4 9	13 22	18 17	28 9				
ST Persei	53.7	+38 47	8.5—10.5	2 15.6	7 16	15 15	23 13					
RX Cassiop.	2 58.8	+67 11	8.6— 9.1	32 07.6							30 21	
Algol	3 01.7	+40 34	2.3— 3.5	2 20.8	3 14	12 4	20 18	29 9				
RT Persei	16.7	+46 12	9.5—11.5	0 20.4	2 17	8 16	20 13	26 12				
λ Tauri	55.1	+12 12	3.3— 4.2	3 22.9	7 0	14 21	22 19	30 17				
RW Tauri	3 57.8	+27 51	7.1— [11	2 18.5	7 21	16 4	24 11					
RV Persei	4 04.2	+33 59	9.5—11.0	1 23.4	3 2	8 23	20 20	26 18				
RW Persei	13.3	+42 04	8.8—11.0	13 04.8	5 18		18 23					
SZ Tauri	31.4	+18 20	7.2— 7.7	3 03.6	6 13	12 20	19 3	25 11				
RS Cephei	4 48.6	+80 06	9.5—12.0	12 10.1	2 13	14 23	27 9					
TT Aurigae	5 02.8	+39 27	7.8— 8.7	0 16.0	5 10	10 23	22 0	27 13				
RY Aurigae	11.5	+38 13	10.7—11.7	2 17.5	3 18	9 5	20 2	25 13				
RZ Aurigae	42.9	+31 40	10.6—13.3	3 00.3	3 19	9 19	21 20	27 20				
SV Tauri	45.8	+28 05	9.4—11.0	2 04.0	5 10	11 22	18 10	24 22				
Z Orionis	50.2	+13 40	9.7—10.7	5 04.9	1 10	11 19	17 0	27 10				
SV Gemin.	54.6	+24 28	9.8— [11	4 00.2	3 3	11 3	19 3	27 4				
RW Gemin.	5 55.4	+23 08	9.5—11.0	2 20.8	3 0	8 18	20 5	25 23				
U Columbæ	6 11.2	—33 03	9.2—10.0	2 19.2	3 20	10 2	22 13	28 19				
SX Gemin.	22.0	+20 37	10.8—11.5	1 08.8	6 8	13 5	20 1	26 20				
RW Monoc.	29.3	+ 8 54	9.0—10.8	1 21.7	8 13	16 5	23 19					
RX Gemin.	43.6	+33 21	8.8— 9.6	12 05.0		7 14	19 19					
RU Monoc.	6 49.4	— 7 28	9.8—10.5	0 21.5	6 9	13 13	20 17	27 21				
R Can. Maj.	7 14.9	—16 12	5.8— 6.4	1 03.3	5 18	12 14	19 9	26 5				
RY Gemin.	21.7	+15 52	8.9— [10	9 07.2	2 18	12 1	21 8	30 15				
Y Camelop.	27.6	+76 17	9.5—12	3 07.3	2 12	9 3	22 8	28 23				
TX Gemin.	30.3	+17 08	10.0—11.9	2 19.2		9 1	17 11	25 20				
RR Puppis	43.5	—41 08	9.4—10.7	6 10.3	2 3	8 13	21 10	27 20				
V Puppis	7 55.4	—48 58	4.1— 4.8	1 10.9	1 10	8 17	23 6	30 12				
X Carinæ	8 29.1	—58 53	7.9— 8.7	0 13.0	3 23	11 0	18 1	25 2				
S Cancri	8 38.2	+19 24	8.2—10	9 11.6	6 23	16 10	25 22					
RX Hydræ	9 00.8	— 7 52	9.1—10.5	2 06.8	7 10	16 13	25 16					
S Velorum	29.4	—44 46	7.8— 9.3	5 22.4	1 12	7 10	19 7	25 5				
Y Leonis	9 31.1	+26 41	9.3—11.2	1 16.5	3 6	10 0	22 12	30 5				
RR Velorum	10 17.8	—41 36	10.0—10.9	1 20.5	3 23	11 9	18 19	26 5				
SS Carinæ	54.2	—61 23	12.2—12.8	3 07.2	2 1	8 15	21 20	28 10				
RW Urs. Maj.	10 35.4	+52 34	10.3—11.4	7 07.9	2 2	9 10	16 18	24 2				
Z Draconis	11 39.8	+72 49	9.9—13.6	1 08.6	4 22	11 17	18 12	25 7				
RZ Centauri	12 55.6	—64 05	8.5— 8.9	1 21.0	5 20	13 8	20 20	28 8				
RS Can. Ven.	13 06.3	+36 28	7.5—12.5	4 19.1	5 2	14 16	19 11	29 2				

Minima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of Minima in 1928 June							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
SS Centauri	13 07.2	−63 37	8.8—10.4	2 11.5	5 13	13 0	20 10	27 21				
SX Hydræ	13 39.0	−26 23	8.6—12.7	2 21.5	5 23	11 18	23 8	29 3				
δ Libræ	14 55.6	− 8 07	4.8— 6.2	2 07.9	3 7	10 7	17 7	24 6				
U Coronæ	15 14.1	+32 01	7.6— 8.7	3 10.9	1 17	8 14	22 10	29 7				
TW Draconis	15 32.4	+64 14	7.3— 8.9	2 19.4		8 23	17 9	25 19				
SS Libræ	15 43.4	−15 14	9.3—11.5	0 18.4	7 11	14 16	21 23	29 1				
SW Ophiuchi	16 11.1	− 6 44	9.2—10.0	2 10.7	3 11	10 19	18 3	25 11				
SX Ophiuchi	12.6	− 6 25	10.5—11.2	2 01.5	4 16	10 21	23 6	29 10				
R Aræ	31.1	−56 48	6.8— 7.9	4 10.2		9 2	17 22	26 19				
TT Herculis	16 49.9	+17 00	8.9— 9.3	20 18.1			19 21					
TU Herculis	17 09.8	+30 50	9.5—12	2 06.4	6 10	13 5	20 0	26 20				
U Ophiuchi	11.5	+ 1 19	6.0— 6.7	1 16.2	2 20	9 13	24 23	29 16				
u Herculis	13.6	+33 12	4.6— 5.4	2 01.2	3 10	9 14	21 21	28 1				
TX Herculis	15.4	+42 00	8.3— 9.0	2 01.4	2 16	8 20	21 5	27 9				
RV Ophiuchi	29.8	+ 7 19	9. —12	3 16.5	4 16	12 1	19 10	26 19				
SZ Herculis	36.0	+33 01	9.5—10.3	0 19.6	5 2	14 22	19 20	29 15				
TX Scorpii	48.6	−34 13	7.5— 8.2	0 22.6	7 3	13 17	20 8	26 22				
UX Herculis	49.7	+16 57	8.8—10.5	1 13.2		11 12	22 8					
Z Herculis	53.6	+15 09	7.1— 7.9	3 23.8	2 15	10 15	18 15	26 14				
WX Sagittarii	53.6	−17 24	9.2—10.8	2 03.1	2 14	8 23	21 18	28 3				
WY Sagittarii	17 54.9	−23 01	9.5—10.6	4 16.0	1 20	11 4	20 12	29 20				
SX Draconis	18 03.0	+58 23	9.3—10.5	5 04.1	5 23	11 4	21 12	26 16				
RS Sagittarii	11.0	−34 08	5.9— 6.3	2 10.0	1 0	8 6	22 18	30 0				
V Serpentis	11.1	−15 34	9.5—11.1	3 10.9	1 1	7 23	21 18	28 16				
RZ Scuti	21.1	− 9 15	7.4— 8.3	15 03.2		15 10	30 14					
RZ Draconis	21.8	+58 50	9.5—10.2	0 13.2	2 9	10 2	17 19	25 12				
RX Herculis	26.0	+12 32	7.0— 7.6	0 21.3		8 13	17 11	26 8				
SX Sagittarii	39.7	−30 36	8.7— 9.8	2 01.8		7 9	15 16	24 0				
RR Draconis	40.8	+62 34	9.3—13	2 19.9	3 14	12 2	20 13	29 1				
RS Scuti	43.7	−10 21	9.3—10.3	0 15.9		8 3	16 3	24 2				
β Lyræ	46.4	+33 15	3.4— 4.1	12 21.8	3 0	15 22	28 20					
U Scuti	18 48.9	−12 44	9.1— 9.6	0 22.9	1 2	8 18	16 9	24 0				
RX Draconis	19 01.1	+58 35	9.3—10.2	1 21.4	7 1	14 15	22 5	29 18				
RV Lyræ	12.5	+32 15	11. —12.8	3 14.4	6 20	14 1	21 6	28 11				
RS Vulpec.	13.4	+22 16	6.9— 8.0	4 11.4	4 17	13 16	22 15					
U Sagittæ	14.4	+19 26	6.5— 9.0	3 09.1	5 7	12 1	18 20	25 14				
Z Vulpec.	17.5	+25 23	7.3— 8.5	2 10.9	4 14	11 23	19 8	26 15				
TT Lyræ	24.3	+41 30	9.4—11.6	5 05.8	4 2	9 8	19 20	25 1				
UZ Draconis	26.1	+68 44	9.0— 9.8	1 15.1	3 4	11 8	19 12	27 15				
SY Cygni	19 42.7	+32 28	10. —12	6 00.2	3 5	9 5	21 5	27 6				
WW Cygni	20 00.6	+41 18	9.3—13.4	3 07.6	7 10	17 9	27 8					
SW Cygni	03.8	+46 01	9. —11.7	4 13.8	7 16	16 19	25 23					
VW Cygni	11.4	+34 12	9.8—11.8	8 10.3	5 6	13 16	22 3	30 13				
RW Capric.	12.2	−17 59	8.8—10.6	3 09.4	6 14	12 8	20 3	26 22				
UW Cygni	19.6	+42 55	10.5—13	3 10.8	7 2	14 23	21 21	27 19				
V Vulpec.	32.3	+26 15	8.2— 9.8	37 19.0				18 1				
W Delphini	33.1	+17 56	9.4—12.1	4 19.4	4 10	14 1	23 15					
RR Delphini	38.9	+13 35	10.5—11.8	4 14.4	2 14	11 19	16 9	25 17				
Y Cygni	48.1	+34 17	7.1— 7.9	2 23.9	5 7	11 7	23 7	29 7				
WZ Cygni	49.3	+38 27	9.9—10.8	0 14.0	5 8	12 11	19 14	26 18				
RR Vulpec.	20 50.5	+27 32	9.6—11.0	5 01.2	1 3	11 5	16 6	26 9				
RY Aquarii	21 14.8	−11 14	8.8—10.4	1 23.2	2 18	8 11	20 11	26 8				
UZ Cygni	55.2	+43 52	8.9—11.6	31 07.3			19 17					
RT Lacertæ	21 57.4	+43 24	9.1—10.5	5 01.7	1 18	11 22	17 0	27 3				
RW Lacertæ	22 40.6	+49 08	10.2—11.2	5 04.4	5 15	10 19	21 4	26 8				
VW Pegasi	22 51.7	+32 42	10.0—10.6	5 06.4	1 20	12 9	17 16	28 6				
Y Piscium	23 29.3	+ 7 22	9.0—12.0	3 18.4	3 19	11 8	18 20	26 10				
TW Androm.	23 58.2	+32 17	8.6—11.5	4 02.9	4 23	13 5	21 11	29 16				

Maxima of Variable Stars of Short Period.

[Calculated by members of the classes in Astronomy at Carleton College.]

Given to the nearest hour in Greenwich civil time; to obtain Eastern Standard time subtract 5^h; Central Standard time 6^h, etc.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich civil times of Maxima in 1928 June							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
SX Cassiop.	0 05.5	+54 20	8.6— 9.2	36 13.7			9 0					
SY Cassiop.	0 09.8	+57 52	9.3— 9.9	4 01.7	4 17		12 21		21 0		29 3	
RR Ceti	1 27.0	+ 0 50	8.3— 9.0	0 13.3	2 19		13 21		19 9		30 11	
RW Cassiop.	1 30.7	+57 15	8.9—11.0	14 19.2			12 5				27 0	
V Arietis	2 09.6	+11 46	8.3— 9.0	0 23.8	7 13		14 12		21 10		28 9	
SU Cassiop.	2 43.0	+68 28	6.5— 7.0	1 22.8	2 15		10 10		18 5		26 0	
RW Camelop.	3 46.2	+58 21	8.2— 9.4	16 00.0	4 20				21 5			
SX Persei	4 10.2	+41 27	10.4—11.2	4 07.0	2 18		11 8		19 22		28 12	
SV Persei	42.8	+42 07	8.8— 9.6	11 03.1			11 20		22 23			
RX Aurigæ	4 54.5	+39 49	7.2— 8.1	11 15.0			10 2		21 17			
SX Aurigæ	5 04.6	+42 02	8.0— 8.7	1 12.8	1 16		7 19		20 2		26 5	
SY Aurigæ	05.5	+42 41	8.4— 9.5	10 03.3			8 11		18 15		28 18	
Y Aurigæ	21.5	+42 21	8.6— 9.6	3 20.6	7 12		15 6		22 23		30 16	
RZ Gemin.	5 56.6	+22 15	9.1—10.0	5 12.7	4 13		10 2		21 3		26 16	
RS Orionis	6 16.5	+14 44	8.2— 8.9	7 13.6	3 9		10 23		18 12		26 2	
T Monoc.	19.8	+ 7 08	5.7— 6.8	27 00.3	6 11							
RT Aurigæ	23.0	+30 33	5.1— 6.0	3 17.5	8 3		15 14		23 1		30 12	
W Gemin.	29.2	+15 24	6.7— 7.5	7 22.0	2 18		10 16		18 14		26 12	
ζ Gemin.	6 58.2	+20 43	3.7— 4.3	10 03.7	5 0		15 3		25 7			
RU Camelop.	7 10.9	+69 51	8.5— 9.8	22 06.5					20 5			
RR Gemin.	7 15.2	+31 04	10.0—11.5	0 09.5	4 10		12 9		20 8		28 6	
V Carinæ	8 26.7	—59 47	7.4— 8.1	6 16.7	6 17		13 9		20 2		26 18	
T Velorum	8 34.4	—47 01	7.6— 8.5	4 15.3	3 4		12 11		17 2		21 17	
V Velorum	9 19.2	—55 32	7.5— 8.2	4 08.9	5 1		13 18		18 3		26 21	
Z Leonis	9 46.4	+27 22	7.9— 9.6	56 08.7								
RR Leonis	10 02.1	+24 29	9.1—10.1	0 10.9	5 3		14 5		18 17		27 18	
SU Draconis	11 32.2	+67 53	8.9— 9.6	0 15.8	6 19		13 10		20 1		26 15	
S Muscæ	12 07.4	—69 36	6.4— 7.3	9 15.8	3 7		12 23		22 15			
SW Draconis	12.8	+70 04	8.8— 9.6	0 13.7	3 11		9 4		20 13		26 6	
T Crucis	15.9	—61 44	6.8— 7.6	6 17.6	5 3		11 21		18 14		25 8	
R Crucis	18.1	—61 04	6.8— 7.9	5 19.8	3 23		9 18		21 10		27 6	
S Crucis	12 48.4	—57 53	6.5— 7.6	4 16.6	3 11		12 20		17 13		27 22	
W Virginis	13 20.9	— 2 52	8.7—10.4	17 06.5	5 0				22 6			
SS Hydræ	25.0	—23 08	7.4— 8.1	8 04.8			9 3		17 7		25 12	
RV Urs. Maj.	13 29.4	+54 31	9.2— 9.9	0 11.2	7 8		16 17		26 1			
ST Virginis	14 22.5	— 0 27	10.3—11.4	0 09.9	4 10		12 14		20 20		29 1	
V Centauri	25.4	—56 27	6.4— 7.8	5 11.9	6 1		11 13		22 13		28 1	
RS Bootis	14 29.3	+32 11	8.9—10.0	0 09.1	6 17		14 6		21 19		29 9	
R Trian. Austr.	15 10.8	—66 08	6.7— 7.4	3 09.3	1 22		8 17		18 21		29 2	
S Trian. Austr.	15 52.2	—63 29	6.4— 7.4	6 07.8	2 3		8 11		21 2		27 10	
S Normæ	16 10.6	—57 39	6.6— 7.6	9 18.1			8 15		18 9		28 3	
RW Draconis	33.7	+58 03	9.6—10.8	0 10.6	2 3		8 18		22 1		28 17	
RV Scorpii	16 51.8	—33 27	6.7— 7.4	6 01.5	7 1		13 2		19 4		25 5	
X Sagittarii	17 41.3	—27 48	4.4— 5.0	7 00.3	7 2		14 3		21 3		28 3	
Y Ophiuchi	47.3	— 6 07	6.1— 6.5	17 02.9	6 13				23 16			
W Sagittarii	17 58.6	—29 35	4.3— 5.1	7 14.3	7 22		15 12		23 2			
Y Sagittarii	18 15.5	—18 54	5.4— 6.2	5 18.6	1 20		7 15		19 4		24 22	
U Sagittarii	26.0	—19 12	6.5— 7.3	6 17.9	5 13		12 7		19 1		25 18	
Y Scuti	32.6	— 8 27	8.7— 9.2	10 08.3	4 10		14 18		25 3			
RZ Lyræ	39.9	+32 42	9.9—11.2	0 12.3	1 14		9 6		16 22		24 14	
RT Scuti	44.1	—10 30	9.1— 9.7	0 11.9	4 12		11 22		19 8		26 19	
κ Pavonis	18 46.6	—67 22	3.8— 5.2	9 02.2	4 20		13 22		22 23			

Maxima of Variable Stars of Short Period—Continued.

Star	R.A. 1900		Decl. 1900		Magnitude	Approx. Period		Greenwich civil times of Maxima in 1928 June							
	h	m	°	′		d	h	d	h	d	h	d	h	d	h
U Aquilæ	19	24.0	— 7	15	6.2— 6.9	7	00.6	7	14	14	15	21	15	28	16
XZ Cygni		30.4	+56	10	8.6— 9.3	0	11.2	2	4	9	4	16	4	23	4
U Vulpec.		32.2	+20	07	6.5— 7.6	7	23.5	4	17	12	16	20	16	28	16
SU Cygni		40.8	+29	01	6.2— 7.0	3	20.3	3	9	11	2	18	18	26	11
η Aquilæ		47.4	+ 0	45	3.7— 4.5	7	04.2	8	2	15	6	22	10	29	15
S Sagittæ		51.5	+16	22	5.6— 6.4	8	09.2	5	13	13	23	22	8		
X Vulpec.	19	53.3	+26	17	9.5—10.5	6	07.7	3	5	9	13	22	4	28	12
X Cygni	20	59.5	+35	14	6.0— 7.0	16	09.3			14	9			30	18
T Vulpec.		47.2	+27	52	5.5— 6.1	4	10.5	2	12	11	9	20	6	29	3
UY Cygni		52.3	+30	03	9.6—10.4	0	13.5	5	6	10	20	22	1	27	16
RV Capric.		55.9	—15	37	9.2—10.1	0	10.7	4	22	13	21	18	8	27	7
TX Cygni	20	56.4	+42	12	8.5— 9.7	14	17.4			11	11			26	4
VY Cygni	21	00.4	+39	34	8.8— 9.5	7	20.6	8	3	16	0	23	20		
SW Aquarii		10.2	— 0	20	9.9—10.8	0	11.0	4	10	13	14	18	4	27	9
VZ Cygni	21	47.7	+42	40	8.2— 9.2	4	20.7	5	22	15	15	20	12	30	5
Y Lacertæ	22	05.2	+50	33	9.1— 9.6	4	07.8	4	0	12	15	21	7	29	22
δ Cephei		25.5	+57	54	3.7— 4.6	5	08.8	4	11	9	20	20	13	25	22
Z Lacertæ		36.9	+56	18	8.2— 9.0	10	21.1	4	13	15	11	26	8		
RR Lacertæ		37.5	+55	55	8.5— 9.2	6	10.1	6	9	12	19	19	5	25	15
V Lacertæ		44.5	+55	48	8.5— 9.5	4	23.6	5	3	15	2	20	1	30	1
X Lacertæ	22	45.0	+55	54	8.2— 8.6	5	10.7	3	18	14	15	20	2	30	23
SW Cassiop.	23	03.7	+58	11	9.2— 9.7	5	10.6	5	23	11	9	22	6	27	17
RS Cassiop.		32.6	+61	52	9.0—11.0	6	07.1	5	6	11	13	24	4	30	11
RY Cassiop.	23	47.2	+58	11	9.3—11.8	12	03.4	2	23	15	3	27	6		

Monthly Report of the American Association of Variable Star Observers, for the Month of March, 1928.

The present report is the best which has been submitted during the month of March for several years past. This is due in great part to the splendid list communicated by our Italian member, Signori Lacchini. We welcome contributions this month from three new observers, Signori Giustino, of Faenza, Italy, and Messrs. Lee and Webb, of St. Petersburg, Florida, and New York, N. Y., respectively.

Observations just at hand from our southern observers confirm the fact that S Apodis, *145971*, is again on the decrease, magnitude 12.0 on March 1. This variable is of the rare R Coronae Borealis type, and has remained at nearly constant maximum brightness, magnitude 10.0, for the last three years. The present decrease to minimum apparently started last November, quite gradual at first, but more rapid during January and February of this year. The preceding minimum began in March, 1924, and lasted about five months, reaching magnitude 13.0 in June, 1924. If the Association attempted no other work than that of observing the irregular variables of this and the SS Cygni type, its existence would be fully justified.

Appended herewith is a list of important errata appearing in the Monthly Report Reprints for 1926 and 1927. If others are noted, kindly inform the Recording Secretary at once, that attention may be called to them in a later issue of the reports.

The next meeting of the Association will be held at the Vassar College Ob-

Variable Star Observations Received During March, 1928.

Jan. 0 = J.D. 2425246; Feb. 0 = J.D. 2425277; Mar. 0 = J.D. 2425306.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
V Scl	T Cas	RR And	RU And	o Cet	W Per
000339	001755	004533	013238	*021403*	024356
249 10.6 Bl	309 9.4 Kz	264 14.4 Bf	267 11.3 Ch	280 7.4 L	295 9.4 Pt
255 10.8 Bl	309 9.5 Eb	270 13.8 Bf	288 12.0 Ch	290 7.7 L	297 9.5 Pt
276 11.0 Bl	R And	RV Cas	295 12.5 Pt	291 8.4 Ch	300 9.5 B
S Scl	001838	004746a	299 12.8 B	295 8.2 Pt	312 9.3 Cl
001032	288 13.1 Ch	308[12.3 B	Y And	297 7.9 L	315 9.3 B
219 8.0 Dr	295 12.0 Fd	— Cas	013338	297 8.7 Ch	319 9.7 Lh
225 8.7 Dr	295 14.0 Pt	004746b	267 11.6 Ch	302 8.4 L	R Hor
226 8.5 Dr	S Tuc	295 10.6 Pt	288 13.4 Ch	S Per	*025050*
229 8.3 Dr	*001862*	W Cas	295 13.2 Pt	021558	247 5.1 Ht
236 9.3 Dr	255 10.5 Bl	004958	299 13.7 B	266 9.5 Ch	249 5.8 Bl
240 8.9 Dr	257 10.4 Sm	295 11.0 Pt	X Cas	278 9.6 By	255 5.8 Bl
249 9.6 Bl	265 9.6 En	300 11.2 B	014958	289 9.9 By	258 5.8 Sm
255 10.2 Bl	266 10.0 Sm	301 10.0 Jo	295 11.5 Pt	289 9.3 Ch	259 4.6 Ht
255 10.0 Sm	270 9.6 En	U Tuc	298 11.5 Bn	295 8.9 Pt	265 5.0 En
259 10.3 Ht	276 9.3 Bl	*005475*	300 10.4 B	296 9.2 By	266 6.1 Sm
262 10.0 Dr	S Cet	255[13.7 Bl	304 10.7 Bn	300 9.7 By	266 4.6 Ht
265 10.0 En	*001909*	266[12.9 Sm	319 11.0 Lh	304 9.8 By	270 5.0 En
266 10.0 Sm	284 12.5 L	270[12.9 En	U Per	307 9.5 By	273 5.1 Ht
266 11.1 Ht	288 12.1 Ch	Z Cet	015254	314 9.6 By	276 5.5 Bl
270 10.4 En	T Phe	*010102*	289 8.7 Ch	315 9.4 B	T Hor
272 10.4 Dr	*002546*	295 14.3 Pt	295 8.6 Pt	R Cet	*025751*
273 10.8 Ht	255 11.5 Bl	U Scl	300 8.6 B	*022000*	249 8.6 Bl
274 10.5 Dr	255 11.6 Sm	*010630*	315 7.9 B	266 11.6 Ch	255 8.1 Bl
275 10.5 Dr	265 10.8 En	255[13.2 Bl	R Ari	RR Per	258 9.3 Sm
276 10.8 Bl	266 10.8 Sm	272[12.0 Dr	021024	022150	266 9.0 Sm
286 11.2 Dr	270 10.2 En	286[12.0 Dr	190 10.0 Wb	289[11.9 Ch	276 10.4 Bl
X And	276 9.6 Bl	U And	225 8.0 Wb	R For	U Ari
001046	T Psc	010940	268 9.7 Ch	*022426*	030514
259 14.4 Bf	002614	296 10.5 Lg	289 10.3 Sw	249 9.0 Bl	259[14.7 Bf
264 14.7 Bf	298 11.2 GC	299 10.7 B	291 10.7 Ch	255 9.2 Bl	270[14.7 Bf
270 14.7 Bf	W Scl	308 10.4 B	295 11.1 Fd	276 9.3 Bl	307[13.1 Wl
299[13.5 B	*002833*	S Cas	295 11.4 Pt	U Cet	X Cet
T Cet	255 13.0 Bl	011272	297 11.4 Fd	*022813*	031401
001620	U Cas	288[13.2 Ch	300 11.5 B	266 8.3 Ch	280 10.3 L
284 6.5 L	004047	RZ Per	W And	286 8.2 Ch	288 9.9 L
T And	295 10.7 Pt	012350	021143a	295 8.3 Pt	288 10.0 An
001726	307 10.9 B	278 9.6 By	268 11.3 Ch	RR Cep	295 10.6 Pt
266 8.9 Wk	309[11.3 Kz	289 9.4 By	291 8.7 Ch	022980	297 10.9 L
266 9.1 Ch	RW And	296 9.5 By	295 8.0 Pt	284 14.1 L	301 11.1 L
277 9.5 Ch	004132	298 9.7 Sp	299 7.8 B	290 14.1 L	Y Per
295 10.3 Ch	288 12.1 Ch	300 9.2 By	308 7.3 B	297[14.5 L	032043
295 10.0 Pt	V And	304 9.3 By	309 7.8 Kz	R Tri	295 8.0 Pt
300 10.9 B	004435	307 9.2 By	309 7.6 Eb	023133	300 9.2 B
T Cas	259 10.1 Bf	312 9.9 Sp	T Per	265 8.5 Ch	315 9.3 B
001755	264 10.1 Bf	314 10.1 By	021258	277 9.2 Ch	319 9.6 Lh
270 10.7 Gt	270 10.5 Bf	R Psc	266 8.8 Ch	288 9.5 Sw	R Per
280 9.5 Gt	298 12.0 GC	012502	286 8.9 Ch	295 10.3 Pt	032335
280 9.4 L	299 12.3 B	251 6.9 Bf	289 9.0 Ch	297 10.3 Ch	299[13.8 B
280 9.7 An	309[11.1 Eb	259 7.1 Bf	295 8.5 Pt	300 10.3 B	305[13.3 Lg
284 10.2 Ch	X Scl	264 7.4 Bf	o Cet	301 9.9 Jo	314[13.4 B
288 9.8 L	*004435*	267 7.5 Ch	*021403*	304 10.6 Sf	U Cam
288 10.1 An	249 11.1 Bl	270 7.6 Bf	264 7.8 Ch	308 10.5 B	033362
295 10.1 Pt	255 11.5 Bl	286 7.8 Ch	265 7.5 En	314 11.2 GC	297 7.9 By
297 8.9 L	276 12.0 Bl	295 8.2 Ch	267 7.9 Ch	318 11.4 Sf	307 7.2 By
301 8.9 L	RR And	295 8.6 Pt	270 8.0 Ch	W Per	T Eri
301 9.5 Jo	004533		270 7.6 En	024356	*035124*
307 9.2 B	259 14.8 Bf		277 8.0 Ch	289 10.0 Ch	219 9.6 Dr

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1928.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
T ERI	T CAM	R PIC	S PIC	S AUR	T ORI
035124	043065	*044349*	*050848*	052034	*053005a*
225 10.1 Dr	316 13.5 Pi	258 7.7 Sm	257[12.9 Sm	289 9.1 Ch	294 10.2 L
226 10.0 Dr	RX TAU	259 7.9 Ht	268[12.9 En	289 7.8 GC	295 10.6 Pt
229 10.3 Dr	043208	266 7.8 Ht	276[13.4 Bl	295 8.2 Pt	296 10.8 L
236 10.8 Dr	295 13.2 Pt	267 7.5 Dr	R AUR	296 8.7 GC	297 11.1 L
262 11.5 Dr	300 12.3 B	268 7.5 En	050953	300 8.8 GC	297 10.6 Pt
267 11.7 Dr	307 12.8 Wl	273 7.5 En	269 8.0 Ch	305 8.7 B	298 11.0 Sp
274 12.0 Dr	314 13.0 Sf	273 7.5 Ht	295 8.2 Pt	309 8.6 Kz	299 11.0 B
286[12.2 Dr	315 12.9 B	274 7.4 Dr	304 8.2 Pi	309 8.9 Eb	299 10.7 L
289 12.3 Dr	R RET	276 7.2 Bl	307 8.4 B	310 9.1 Wl	300 10.3 L
V ERI	*043263*	286 7.3 Dr	309 8.4 Kz	318 9.2 Sp	301 10.2 L
035016	247 7.6 Ht	289 7.1 Dr	309 8.5 Eb	W AUR	301 10.4 Pt
297 8.8 By	249 7.5 Bl	V TAU	316 8.9 Wl	052036	302 10.8 L
307 9.1 By	255 7.5 Bl	044617	321 9.0 Pi	284 12.1 L	302 11.0 GC
T TAU	258 7.8 Sm	270 10.4 Ch	T PIC	290 12.2 L	303 11.9 L
041619	259 7.5 Ht	288 10.8 Ch	*051247*	295 11.7 Pt	303 10.3 Pt
278 10.2 By	265 8.2 En	289 11.4 GC	247 8.8 Ht	299 11.3 L	304 10.4 Pt
289 10.3 By	266 7.2 Sm	295 11.4 Pt	249 8.5 Bl	305 10.6 B	304 11.8 L
297 10.4 By	266 7.8 Ht	299 12.0 B	255 8.7 Bl	308 10.8 GC	305 11.7 L
300 10.2 By	270 8.3 En	307 12.8 Wl	258 8.8 Sm	309 10.6 Eb	305 10.6 Pt
307 10.2 By	273 7.6 Ht	308 12.5 B	259 9.0 Ht	309 10.3 Kz	305 11.6 Gt
314 10.2 By	275 8.7 En	R ORI	266 9.5 Ht	310 10.1 Wl	306 10.6 Pt
R TAU	276 7.8 Bl	045307	268 9.2 En	321 9.1 Pi	308 11.3 B
042209	X CAM	299 11.7 B	273 10.1 En	S ORI	309 10.9 Eb
261 9.9 Bf	043274	307 11.5 Wl	273 10.1 Ht	*052404*	309 11.0 Kz
267 10.2 Bf	288 10.9 Ch	R LEP	275 10.1 Dr	278 9.9 An	311 10.5 Pt
270 9.7 Ch	295 11.4 Pt	*045514*	276 9.8 Bl	288 10.0 An	313 10.5 Pt
272 10.6 Bf	314 12.8 B	190 8.8 Wb	286 12.0 Dr	290 10.1 An	314 10.0 Sp
291 10.6 Ch	316 12.5 Wl	228 9.0 Wb	289 12.0 Dr	293 10.2 An	316 10.1 Pt
295 10.6 Pt	R DOR	270 10.0 Ch	T COL	294 10.3 An	318 10.3 Sp
299 10.5 B	*043562*	278 9.0 L	*051533*	295 9.3 Pt	AN ORI
308 10.6 B	247 5.5 Ht	285 8.7 L	219 7.9 Dr	300 9.5 B	*053005t*
W TAU	249 6.3 Bl	290 9.9 Ch	225 7.5 Dr	300 10.3 An	284 11.4 L
042215	255 5.5 Bl	292 8.4 L	226 7.4 Dr	302 10.2 An	289 11.0 L
295 10.0 Pt	258 5.8 Sm	295 8 5 Pt	227 7.5 Dr	303 11.5 An	292 10.7 L
298 9.8 Sp	259 5 5 Ht	299 8.8 L	229 7.4 Dr	304 10.5 An	293 10.6 L
299 10.6 B	265 5.5 En	301 8.5 Jo	236 7.2 Dr	309 9.3 Kz	296 11.1 L
301 10.0 Jo	266 5.2 Sm	305 8.3 L	247 7.2 Ht	309 9.5 Eb	297 10.9 L
303 10.4 GC	266 5.8 Ht	307 8.9 B	249 7.7 Bl	315 9,4 B	299 11.0 L
307 10.6 Wl	270 5.8 En	314 8.5 Jo	255 7.5 Bl	319 9.7 Lh	301 10.7 L
308 10.4 B	273 5.8 Ht	V ORI	257 7.7 Sm	T ORI	302 11.0 L
314 9.8 Jo	274 5.5 En	050003	258 7.7 Dr	*053005a*	303 11.7 L
318 9.9 Sp	276 5.5 Bl	270 11.5 Ch	259 8.1 Ht	259 10.2 Gt	304 11.4 L
318 10.5 Bh	R CAE	291 12.6 Ch	266 8.4 Ht	267 10.3 Gt	305 11.4 L
S TAU	*043738*	295 12.6 Pt	266 8.1 En	277 11.2 Gt	S CAM
042309	259[12.0 Ht	297 13.3 Lg	266 8.1 Sm	278 10.6 L	053068
261[14.8 Bf	268[12.0 En	300 13.0 B	266 8.3 Dr	278 11.0 Gt	295 8.4 Pt
267 15.1 Bf	276[12.0 Bl	315 13.7 B	267 8.3 Dr	280 10.6 L	316 9.0 Wl
272[14.8 Bf	R PIC	T LEP	273 8.7 En	284 10.1 L	RR TAU
299[13.5 B	*044349*	*050022*	273 8.6 Ht	284 10.2 Gt	053326
308[12.0 B	219 9.2 Dr	249 8.2 Bl	274 8.5 Dr	286 10.1 L	252 12.2 Bf
T CAM	225 9.2 Dr	255 8.1 Bl	276 8.5 Bl	288 10.1 L	261 11.9 Bf
043065	226 9.0 Dr	261 8.0 Bf	286 9.7 Dr	289 10.1 L	267 12.2 Bf
284 13.4 L	229 8.8 Dr	267 8.0 Bf	289 10.1 Dr	289 10.0 GC	272 12.1 Bf
293 13.8 L	236 8.4 Dr	272 8.2 Bf	299 10.3 Bh	290 10.1 L	289 13.3 GC
295 14.2 Pt	240 8.4 Dr	276 8.1 Bl	302 10.7 Lg	291 10.1 L	RU AUR
299 13.8 L	247 8.2 Ht	295 8.4 Pt	S AUR	292 10.2 L	053337
305 13.6 Lg	249 7.7 Bl	299 7.9 B	052034	293 10.2 Gt	289 10.5 By
313 13.6 GC	255 7.7 Bl	314 8.8 B	269 9.0 Ch	293 10.1 L	295 9.9 Pt

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1928.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
RU AUR	SU TAU	α ORI	X AUR	X GEM	R CMI
053337	054319	054907	060450	064030	070310
297 10.7 By	303 9.7 Pt	259 1.0 An	273 9.2 Ch	310 10.1 Wl	268 9.8 Ch
300 10.8 By	303 9.5 L	259 0.8 Gt	288 10.9 Ch	312 9.0 Sp	278 9.5 L
304 11.0 By	303 9 2 By	267 0.9 Gt	292 11.5 Ch	316 8.7 Bn	285 9.7 L
304 10.6 Pi	303 9.4 An	270 0.9 Gt	295 11.9 Pt	319 8.8 Bn	289 10.3 By
307 11.1 By	304 9.6 Pt	278 0.8 Gt	296 11.6 Ch	W MON	291 10.8 Lg
308 11.1 By	304 9.3 L	293 0.8 Gt	298 10.0 Rt	*064707*	292 9.5 L
309 10.3 Kz	304 9.2 By	299 1.0 L	309[11.2 Kz	295 9.4 Pt	297 10.4 By
309 10.2 Eb	305 9.4 Gt	301 1.0 L	315 13.4 B	Y MON	299 10.0 L
310 10.6 Wl	305 9.4 L	302 1.1 L	316 13.0 Wl	065111	304 10.5 L
321 11.6 Pi	306 9.6 Pt	303 1.0 L	V AUR	293 13 5 Lg	304 11.3 Lg
321 11.2 Sf	307 9.3 By	304 1.1 L	061647	295 13.3 Pt	304 10.7 An
U AUR	307 9.5 B	U ORI	301 11.6 Sp	297 13.4 Lg	305 10.2 B
053531	311 9.6 Pt	054920a	304 11.8 Pi	304 13.3 Lg	308 10.6 By
269 9.6 Ch	312 9.7 Sp	*276* 10.0 Ch	315 11.1 B	X MON	314 11.4 Lg
289 11.0 Ch	312 9.6 Cl	295 10.4 Pt	318 11.5 Sp	*065208*	R VOL
295 11.0 Pt	313 9.7 Pt	295 11.0 Fd	V MON	268 8.4 Ch	*070772*
305 10.5 B	314 9.5 B	298 10.2 Rt	*061702*	278 7.9 L	247[12.6 Ht
309 11.2 Kz	316 9.7 Pt	300 11.0 Fd	268 8.9 Ch	285 7.7 L	257[12.6 Sm
309 11.2 Eb	316 9.7 Sf	307 10.3 B	290 9.6 Ch	290 7.8 Ch	268[13.4 En
310 11.3 Wl	317 9.3 Bh	309 10.2 Kz	295 9.8 Pt	292 7.7 L	273[13.4 Ht
Y TAU	318 9.5 Bh	309 10.6 Eb	297 10.6 By	298 7.8 Rt	287[11.8 Dr
053920	318 9.6 Sp	313 11.2 Fd	307 10.5 By	299 7.8 L	L_2 PUP
297 6.8 By	S COL	321 11.5 Fd	AG AUR	R LYN	*071044*
307 6.8 By	*054331*	UW ORI	062047	065355	226 4.3 Dr
SU TAU	247 9.6 Ht	054920b	280 8.9 L	289 12.8 Ch	229 4.0 Dr
054319	249 9.4 Bl	309 10.4 Eb	284 9.2 L	321[11.9 Pi	240 4.0 Dr
267 9.7 Ch	255 9.4 Bl	309 10.3 Kz	286 9.3 L	V CMI	266 3.6 Dr
270 9.4 Gt	257 9.8 Sm	V CAM	293 9.4 L	070109	287 3.9 Dr
276 9.8 Ch	259 10.2 Ht	054974	300 9.2 L	288 13.1 Ch	288 3 9 Dr
278 9.6 Gt	266 10.2 Ht	316[12.8 Wl	Z MON	291 13.6 Lg	289 3.9 Dr
278 9.4 An	266 9.6 Sm	Z AUR	*062808*	309 10.6 Wd	317 4.1 Bh
278 9.7 L	266 10.2 En	055353	297 8.7 By	315 13.8 B	RR MON
284 9.5 Gt	273 10.1 En	269 10.6 Ch	307 8.5 By	R GEM	071201
284 9.5 An	273 10.1 Ht	290 10.8 Ch	R MON	070122a	268 9.2 Ch
284 9.5 L	276 9.7 Bl	297 11.0 Pt	063308	274 7.6 Ch	290 9.4 Ch
289 9.8 L	Z TAU	301 10.9 Pt	295 10.8 Pt	282 7.7 Sw	291 9.0 GC
289 10.1 By	054615a	302 10.9 Pt	NOV PIC	292 8.2 Ch	293 9.4 Lg
290 9.7 L	261 12.9 Bf	303 11.2 Pt	*063462*	295 8.4 Pt	296 9.6 Bv
290 9.8 Ch	267 13.8 Bf	304 11.1 Pt	247 6.8 Ht	298 8.5 Sw	297 9.8 Sf
292 9.9 An	272 13.6 Bf	304 10.8 Pi	257 6.5 Sm	301 8.0 Jo	297 9.3 Lg
292 9.7 L	RU TAU	305 11.0 Pt	259 6.7 Ht	309 9.5 Wd	303 9.6 By
293 9.5 L	054615c	305 11.0 Pt	265 6.8 En	311 9.6 Wd	304 9.8 By
293 9.8 Ch	261 12.5 Bf	306 10.9 Pt	266 6.8 Ht	312 9.4 Wd	304 9.6 Lg
293 9.5 Gt	267 12.8 Bf	310 10.9 Pt	269 6.5 Sm	312 9.5 Wl	307 9.8 By
295 9.6 Pt	272 12.7 Bf	311 11.0 Pt	273 6.9 Ht	314 8.8 Jo	308 9.8 By
296 9.6 By	R COL	313 11.0 Pt	273 6.8 En	314 9.5 Sp	314 10 4 Sf
297 9.6 L	*054629*	315 10.5 B	S LYN	316 8.5 Al	314 9.8 Lg
297 9.6 Pt	247 10.6 Ht	316 10.8 Pt	063558	316 9.4 Wd	326 11.0 Pn
298 9.8 Sp	249 10.2 Bl	316 10.6 Wl	289 13.4 Ch	318 9 8 Wd	V GEM
298 9.7 Lg	255 10.4 Bl	321 10.3 Pi	295 12.9 Pt	320 8.6 Al	071713
299 9.5 Bh	257 10.2 Sm	R OCT	318 11.4 Wl	326 9.2 Pn	293 11.3 Lg
299 9.6 L	259 9.9 Ht	*055686*	321 11.3 GC	Z GEM	295 10.6 Pt
300 9.4 An	266 9.3 Ht	257 11.3 Sm	X GEM	070122b	304 10.9 Lg
300 9.4 L	266 9.3 Sm	276 11.5 Bl	064030	295 12.5 Pt	326 9.3 Pn
300 9.6 Lg	266 9.3 En	X AUR	294 8.6 Bn	309 10.5 Wd	S CMI
301 9.6 Pt	273 8 4 En	060450	298 8.6 Bn	TW GEM	072708
301 9.6 L	273 8.9 Ht	264 8.7 Ch	298 8.6 Sp	070122c	228 7.6 Wb
301 9 5 Lg	276 9.0 Bl	269 8 9 Ch	303 8.6 Bn	295 8.0 Pt	271 8.7 Ch

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1928.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
S CMI			S VOL			Z CAM			T HYA			Y VEL			R LEO		
072708			*073173*			081473			*085008*			*092551*			094211		
276	8.8	Wb	269	12.2	Sm	300	10.6	L	292	9.7	Ch	273	10.4	En	231	6.5	Wb
291	9.0	Ch	273	11.4	Ht	301	11.0	L	292	9.2	L	274	10.3	Dr	264	7.4	Ch
295	9.7	Fd	273	11.6	En	302	11.3	L	293	9.6	Lg	276	10.2	Bl	268	7.6	Go
295	9.2	Pt	274	11.6	Dr	303	11.8	L	295	9.5	Pt	287	9.5	Dr	271	8.2	Go
297	9.8	Fd	276	11.5	Bl	303	11.7	An	299	10.0	L	R CAR			271	7.0	Wb
297	9.3	Ch	286	10.8	Dr	304	11.6	L	T CNC			*092962*			274	8.0	Ch
297	9.5	Rt	U CMI			305	11.7	L	085120			219	9.2	Dr	274	7.9	Go
301	9.0	Jo	073508			305	10.6	Gt	264	9.4	Ch	225	9.1	Dr	276	8.0	Go
302	9.7	Fd	285	13.1	L	V CNC			274	9.3	Ch	226	9.1	Dr	278	7.8	An
303	9.7	Fd	292	13.3	L	081617			288	9.3	Ch	227	8.8	Dr	288	8.6	An
305	9.4	B	205	12.8	Pt	264	7.8	Ch	292	9.4	Ch	229	8.8	Dr	291	8.5	Ch
308	9.9	Fd	299	13.1	L	274	8.0	Ch	295	8.7	Pt	236	8.5	Dr	293	8.6	An
309	9.5	Rt	304	12.7	L	288	8.8	Ch	303	9.7	By	240	8.0	Dr	295	8.0	Pt
311	9.9	Fd	315	11.8	B	292	8.0	Ch	308	9.5	By	247	8.1	Ht	295	9.0	Fd
313	9.9	Fd	S GEM			295	8.6	Pt	318	10.1	Pi	249	8.0	Bl	297	9.0	Fd
314	8.9	Jo	073723			298	9.0	Sw	Y HYA			255	7.9	Bl	298	8.4	Rt
315	9.8	Fd	295	14.7	Pt	318	10.0	Pi	*090024*			255	7.6	Sm	300	9.0	Fd
316	9.8	Al	W PUP			320	10.3	Mh	297	12.8	GC	258	7.4	Dr	301	8.8	Fd
318	10.1	Fd	*074241*			RT HYA			302	12.9	GC	259	7.7	Ht	301	8.2	Jo
320	9.8	Al	247	11.9	Ht	*082405*			V UMA			266	7.9	Ht	303	8.8	An
320	9.8	Mh	249	11.7	Bl	295	7.8	Pt	090151			266	7.0	Sm	303	8.9	Fd
320	9.5	Wb	255	12.8	Bl	R CHA			280	10.4	L	266	7.3	En	304	9.0	Fd
321	10.1	Pi	257	11.9	Sm	*082476*			288	10.3	L	266	7.3	Dr	305	8.4	B
321	10.1	Fd	266	12.6	Sm	255	11.8	Sm	297	10.1	L	267	7.4	Dr	308	8.8	Fd
322	10.2	Fd	273	12.8	Ht	266	11.5	Sm	301	10.3	L	270	8.1	En	311	8.9	Fd
T CMI			275	13.1	En	266	11.3	En	W CNC			273	7.6	Ht	313	9.0	Fd
072811			T GEM			270	11.2	En	090425			274	7.3	Dr	314	8.6	Jo
293	10.1	Lg	074323			275	10.6	En	278	12.6	L	276	7.0	Bl	315	9.1	Fd
297	10.1	Sp	295	13.8	Pt	276	10.3	Bl	286	14.0	L	284	6.8	Dr	318	9.3	Fd
301	10.0	Sp	312	13.1	Wl	U CNC			297	13.2	L	286	7.0	Dr	318	9.0	Pi
304	10.0	Lg	U PUP			083019			302	12.0	L	288	6.9	Dr	320	8.8	Mh
305	10.1	B	*075612*			318	11.9	Pi	314	12.6	Sf	289	6.8	Dr	320	8.4	Al
312	10.2	Sp	289	13.3	GC	X UMA			318	11.4	Pi	X HYA			320	9.2	Wb
X PUP			307	12.5	B	083350			RS CNC			*093014*			322	9.5	Fd
072820a			R CNC			295	10.7	Pt	090431			255	11.8	Bf	X LEO		
289	8.8	By	081112			305	11.0	B	257	6.2	Go	266	12.6	Bf	094512		
303	8.3	By	264	9.6	Ch	RV HYA			259	6.2	Go	273	12.8	Bf	288	13.9	L
Z PUP			268	9.5	Go	*083409*			267	6.0	Go	288	12.7	Ch	289	13.9	L
072820b			284	8.9	Ch	303	8.5	By	268	5.9	Go	293	12.8	Lg	291	12.3	L
252	7.3	Bf	295	8.6	Pt	308	8.4	By	271	5.9	Go	295	13.5	Pt	292	14.2	L
261	7.3	Bf	305	8.7	B	S HYA			274	6.1	Go	300	12.9	B	293	13.3	L
267	7.4	Bf	313	8.7	Fd	084803			286	6.1	Go	Y DRA			296	14.2	L
270	7.5	Bf	315	8.7	Fd	264	8.0	Ch	288	6.4	Go	093178			297	13.9	L
273	7.6	Bf	318	8.5	Fd	286	8.7	Ch	RW CAR			274	8.8	Ch	299	13.9	L
289	8.1	By	320	8.6	Wb	292	9.4	Ch	*091868*			R LMI			300	12.2	L
297	8.2	By	320	8.5	Mh	293	9.4	Lg	249	9.9	Bl	093934			301	12.3	L
303	8.1	By	321	8.5	Pi	295	9.3	Pt	255	10.4	Bl	272	12.0	Ch	302	12.7	L
304	8.2	By	321	8.5	Fd	X CNC			266	11.4	En	286	11.8	Ch	303	12.8	L
307	8.2	By	322	8.4	Fd	084917			273	11.7	En	295	11.6	Ch	304	13.9	L
S VOL			Z CAM			303	6.5	By	274	11.7	Dr	295	11.2	Pt	Y HYA		
073173			081473			308	6.3	By	276	12.0	Bl	296	11.1	GC	*094622*		
247	11.4	Ht	280	10.9	L	T HYA			286	11.0	Dr	318	11.1	Fd	295	6.5	Pt
249	11.4	Bl	286	12.9	L	*085008*			Y VEL			320	10.0	Al	304	6.6	By
255	11.6	Bl	290	12.8	L	264	8.4	Ch	*092551*			322	8.8	Fd	Z VEL		
257	11.8	Sm	292	12.6	L	274	9.0	Ch	255	12.0	Bl	324	10.0	Gs	*094953*		
259	11.4	Ht	293	12.7	L	278	9.0	L	257	12.4	Sm	R LEO			259	12.8	Ht
266	11.4	Ht	297	12.2	L	285	9.3	L	266	11.1	Sm	094211			270	12.1	En
268	11.4	En	299	10.7	L	289	9.6	Sw	268	10.8	En	190	6.0	Wb	266	12.8	Sm

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
Z VEL	Z CAR	W LEO	R CRV	RS UMA	V VIR
094953	*101058*	108414	*121418*	123459	*132202*
276[12.8 Bl	268 12.3 En	318[11.9 Pi	255 11.6 Bf	300 10.2 B	297 11.6 Lg
287[12.1 Dr	273 12.6 En	RS CAR	266 11.4 Bf	316 10.2 Al	302 8.5 Pt
V LEO	276 12.3 Bl	*110361*	273 11.0 Bf	318 10.9 Bh	R HYA
095421	W VEL	255[12.3 Sm	278 10.9 L	318 10.4 Pi	*132422*
264 11.8 Ch	*101153*	266[12.3 Sm	286 10.3 L	Y UMA	274 8.1 Ch
274 12.0 Ch	249 9.4 Bl	268[12.3 En	293 9.7 L	123556	284 7.8 L
288 13.0 Ch	255 9.4 Bl	273[12.3 En	295 10.2 Pt	308 9.0 B	291 8.5 L
295 12.8 Pt	257 9.3 Sm	S LEO	299 9.4 L	S UMA	299 8.2 L
303 13.2 GC	266 9.5 Sm	110506	304 8.9 L	123961	304 8.6 L
305 13.3 B	276 9.3 Bl	305[12.8 B	SS VIR	235 9.2 Wb	S VIR
RV CAR	U HYA	RY CAR	122001	268 10.7 Ch	*132706*
095563	*103212*	*111561*	284 7.7 L	278 11.4 An	290 10.9 Ch
276[13.1 Bl	265 5.2 Ch	255[13.1 Bl	291 7.8 L	288 11.3 Ch	295 9.8 Lg
287[12.5 Dr	278 4.8 L	276 13.5 Bl	299 7.8 L	293 11.8 An	302 10.4 Pt
RY LEO	289 5.2 L	288[12.1 Dr	304 7.8 L	295 12.0 Fd	307 9.6 Sp
095814	289 5.5 Ch	289[12.1 Dr	T CVN	295 11.5 Pt	RV CEN
301 9.7 Kl	293 5.1 L	RS CEN	122532	300 11.7 B	*133155*
302 9.7 Kl	299 4.9 L	*111661*	274 10.3 Ch	304 11.4 An	249 8.2 Bl
314 9.5 Kl	RZ CAR	249 11.1 Bl	295 9.5 Pt	314 11.0 Kl	255 8.4 Bl
317 9.6 Kl	*103270*	255 11.9 Bl	318 9.8 Pi	316 11.5 Al	276 8.4 Bl
318 9.6 Kl	275[12.4 Dr	257 12.1 Sm	Y VIR	317 10.9 Kl	289 8.0 Dr
323 9.2 Kl	288[12.4 Dr	266 12.7 Sm	*122803*	318 11.0 Kl	T UMI
S CAR	289[12.4 Dr	276 12.1 Bl	255 10.4 Bf	318 11.0 Pi	133273
100661	R UMA	288[12.1 Dr	266 9.6 Bf	318 11.3 Bh	321[11.4 Pi
219 6.0 Dr	103769	289[12.1 Dr	273 9.4 Bf	RU VIR	T CEN
225 6.0 Dr	288 11.6 Ch	W CEN	284 9.0 L	124204	*133633*
226 6.0 Dr	293 11.1 GC	*115058*	291 9.4 L	295 12.6 Pt	227 5.6 Dr
227 6.1 Dr	295 11.0 Pt	247 8.3 Ht	297 9.8 Lg	297 12.8 Lg	266 7.6 Dr
229 6.0 Dr	297 10.8 Sw	249 8.0 Bl	299 9.9 L	U VIR	267 7.8 Dr
236 6.5 Dr	299 10.8 B	255 7.9 Bl	304 9.1 L	124606	273 7.8 Ht
240 6.9 Dr	304 10.6 Fd	258 8.2 Sm	U CEN	297 8.9 Lg	286 7.1 Dr
247 6.8 Ht	307 10.5 Wd	259 8.3 Ht	*122854*	302 8.6 Pt	289 7.2 Dr
249 6.9 Bl	309 10.5 Wd	266 8.5 Ht	249 10.5 Bl	RV VIR	RT CEN
255 7.5 Bl	311 10.1 Wd	266 8.3 Sm	255 10.6 Bl	*130212*	*134236*
258 7.9 Dr	314 10.3 B	273 9.1 Ht	276 11.7 Bl	297[14.0 Lg	228 11.0 Dr
259 8.0 Ht	315 10.6 Fd	276 8.6 Bl	T UMA	U OCT	273 10.1 Ht
265 8.7 En	316 10.2 Wd	Z UMA	123160	*131283*	R CVN
266 8.4 Sm	318 9.9 Wd	115158	235 9.3 Wb	247 8.8 Ht	134440
266 8.4 Dr	318 10.3 Pi	268 7.3 Go	295 12.6 Pt	249 8.7 Bl	302 10.8 Pt
266 8.8 Ht	318 10.4 Fd	271 7.2 Go	317 11.0 Kl	255 9.2 Bl	318 10.6 Pi
267 8.5 Dr	320 9.7 Mh	274 6.9 Go	318 12.0 Bh	257 9.4 Sm	T APS
273 8.7 En	322 9.9 Fd	277 7.0 Go	318 11.0 Kl	259 9.4 Ht	*134677*
273 9.5 Ht	324 10.0 Go	286 6.7 Go	R VIR	266 9.8 Ht	257[12.7 Sm
274 8.9 Dr	V HYA	288 6.9 Go	123307	266 9.4 Sm	RR VIR
276 8.5 Bl	*104620*	R COM	288 8.2 Ch	268 9.7 En	135908
284 9.0 Dr	249 8.6 Bl	115919	295 9.7 Pt	273 9.8 En	297 11.4 Lg
286 8.6 Dr	255 8.5 Bl	318 11.8 Pi	298 9.2 Rt	273 10.3 Ht	302 11.5 Pt
288 8.5 Dr	268 9.4 Ch	SU VIR	RS UMA	276 10.3 Bl	Z VIR
289 8.6 Dr	274 9.3 Ch	120012	123459	288 10.9 Dr	*140512*
U UMA	276 8.8 Bl	274[12.0 Ch	255 9.9 Bf	V CVN	297[14.0 Lg
100860	284 8.2 L	295 13.1 Lg	266 9.8 Bf	131546	R CEN
308 6.7 By	289 9.3 Ch	318[12.0 Pi	273 9.6 Bf	268 7.7 Gc	*140959*
Z CAR	293 9.0 L	T VIR	274 9.2 Ch	288 6.4 Go	227 7.5 Dr
101058	295 8.4 Pt	*120005*	293 9.1 Ch	W VIR	236 8.0 Dr
249 11.7 Bl	299 8.9 L	295 10.1 Pt	295 10.1 Fd	*132002*	240 7.9 Dr
255 12.3 Bl	W LEO	297 10.4 Lg	295 10.2 Pt	297 8.8 Lg	249 8.2 Bl
257 12.3 Sm	104814		297 9.9 Rt		255 8.6 Bl
266 12.5 Sm	266 14.5 Bf		298 10.1 Rt		258 8.1 Dr

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
R CEN	T LIB	R CRB	SX HER	SS HER	Z OPH
140959	*150519*	154428	160325	162807	171401
259 8.9 Ht	297[14.0 Lg	274 6.2 Ch	263 8.0 Pt	284 10.5 L	302 10.8 Pt
266 8.8 Ht	Y LIB	278 6.1 L	266 7.9 Pt	291 11.3 L	RS HER
266 8.3 Sm	*150605*	284 6.0 L	267 7.9 Pt	299 11.6 L	171723
266 8.2 Dr	278 8.8 L	286 6.0 L	268 7.9 Pt	302 12.0 Pt	302 11.6 Pt
273 9.1 Ht	286 9.0 L	291 5.9 L	271 7.9 Pt	305 11.9 L	S OCT
274 8.5 Dr	293 8.9 L	292 5.9 L	273 7.9 Pt	T OPH	*172486*
276 9.0 Bl	297 9.0 Lg	293 6.0 Gb	274 8.0 Pt	*162815*	247 10.9 Ht
288 8.7 Dr	299 9.5 L	293 6.0 Pt	276 7.9 Pt	296 13.2 L	248 10.6 Bl
289 8.6 Dr	302 9.8 Pt	295 6.0 Pt	279 8.0 Pt	302 13.1 L	255 11.5 Bl
U UMI	304 9.8 L	297 6.1 Pt	284 7.6 L	S OPH	257 11.8 Sm
141567	S LIB	297 5.9 Sp	290 8.1 L	*162816*	259 12.0 Ht
159 8.9 Wb	*151520*	297 6.2 Ch	300 8.1 Pt	290[13.1 L	265 12.0 En
235 9.9 Wb	284 8.7 L	298 6.0 Sp	301 8.0 Pt	296 13.7 L	266 12.3 Ht
274 10.7 Ch	291 9.1 L	300 6.0 Pt	302 8.1 Pt	302 14.0 L	273 12.5 Ht
290 11.0 Ch	295 8.6 Ch	301 6.1 Pt	303 8.2 Pt	W HER	273 12.3 En
302 11.4 Pt	299 8.4 L	302 6.1 Pt	304 8.1 Pt	163137	RU OPH
S Boo	302 8.4 Pt	303 6.1 Pt	305 8.1 L	295[12.0 Fd	172809
141954	304 8.4 L	304 6.2 Pt	308 8.3 Pt	302 13.0 Pt	302 9.8 Pt
284 11.7 L	S SER	304 6.0 L	310 8.2 Pt	322[11.0 Fd	RT SER
291 12.0 L	151714	305 6.1 L	RU HER	R DRA	*173212*
300 12.5 L	293 14.1 L	307 5.9 Sp	160625a	163266	290 12.0 L
302 12.6 Pt	297 12.3 Lg	308 6.2 Pt	290 13.9 L	295 9.8 Fd	299 11.8 L
305 12.6 L	299 14.0 L	310 6.1 Pt	299 13.7 L	301 8.8 Jo	305 11.9 L
RS VIR	304 13.6 L	313 6.1 Pt	302 14.2 Pt	302 9.6 Pt	RS OPH
142205	S CRB	316 6.0 Sp	305 13.5 L	302 9.7 Fd	174406
255 8.6 Bf	151731	320 6.5 Mh	R SCO	304 9.4 Fd	302 11.1 Pt
V Boo	277 9.0 Ch	R SER	*161122a*	309 8.4 Rt	RY HER
142539a	295 9.6 Fd	154615	255 11.2 Bf	313 8.7 Fd	175519
293 9.5 Gb	301 9.9 Fd	277 5.8 Ch	266 11.9 Bf	314 8.4 Jo	277 9.3 Ch
295 9.5 Fd	302 10.5 Fd	302 6.9 Pt	273 12.4 Bf	318 8.3 Fd	297 10.1 Ch
298 9.6 Rt	302 10.3 Pt	V CRB	S SCO	322 8.1 Fd	302 10.4 Pt
300 9.8 Fd	308 11.5 Fd	154639	*161122b*	TX DRA	V DRA
301 9.8 Fd	321 11.0 Fd	302 9.8 Pt	255 11.5 Bf	163360	175654
302 10.2 Fd	322 11.0 Fd	RR LIB	266 10.6 Bf	288 7.6 Go	302 10.8 Pt
302 9.6 Pt	RS LIB	*155018*	273 11.2 Bf	RR OPH	T HER
303 10.1 Fd	*151822*	277 12.2 Ch	302 13.2 Pt	*164319*	180531
304 10.3 Fd	284 11.5 L	284 12.5 L	W CRB	255 13.2 Bf	286 12.5 L
313 10.4 Fd	292 11.1 L	291 12.7 L	161138	266 13.1 Bf	296 10.7 L
315 10.2 Fd	299 10.8 L	296 13.5 L	295[12.0 Fd	273 12.4 Bf	297 11.2 Ch
318 10.5 Fd	304 10.1 L	300 13.3 L	307[11.0 Sp	290 13.0 L	300 10.7 L
318 10.5 Pi	RU LIB	302 13.5 Pt	322[12.0 Fd	299 10.7 L	308 10.8 Fd
322 10.9 Fd	*152714*	RZ SCO	W OPH	302 10.5 Pt	322 9.2 Fd
R Boo	290[12.5 L	*155823*	*161607*	305 10.5 L	W DRA
143227	296 14.3 L	302 11.1 Pt	290[13.7 L	S HER	180565
274 7.5 Ch	300 14.2 L	Z SCO	296[13.9 L	164715	302 9.8 Pt
297 7.6 Rt	W LIB	*160021*	300[14.5 L	295 10.0 Ch	NOV OPH
302 7.5 Pt	*153215*	284 11.3 L	V OPH	302 9.5 Pt	180911
309 8.0 Rt	296 11.2 L	292 11.6 L	*162112*	SS OPH	302[12.5 Pt
S APS	297 10.8 Lg	299 11.7 L	302 8.8 Pt	*165202*	TV HER
145971	300 10.6 L	305 11.7 L	U HER	302 12.5 Pt	181031
249 10.7 Bl	S UMI	R HER	162119	RV HER	300[14.0 L
255 10.6 Bl	153378	160118	295 11.0 Ch	165631	RY OPH
276 10.8 Bl	298 8.6 Rt	295[12.0 Fd	302 11.4 Pt	302 13.3 Pt	181103
RT LIB	302 8.6 Pt	322[12.0 Fd	Y SCO	R OPH	302 12.2 Pt
150018	309 8.5 Rt	U SER	*162319*	*170215*	W LYR
297 13.7 Lg	T NOR	160210	293[13.5 L	277 9.9 Ch	181136
302 13.4 Pt	*153654*	302 13.6 Pt	296[14.0 L	295 10.5 Ch	302 12.1 Pt
	273 11.8 Ht	322[12.3 Fd	320[14.5 L	302 10.6 Pt	

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
SV HER	TY AQL	TU CYG	SX CYG	X CEP	Y PEG
182224	190907	194348	201130	210382	220613
286 13.1 L	302 10.4 Pt	320 12.7 Pt	303 12.2 Pt	302[12.4 GC	259 12.0 Bf
296 13.2 L	S LYR	χ CYG	RT SGR	R EQU	264 11.6 Bf
300 13.0 L	190925	194632	*201139*	210812	270 10.7 Bf
X OPH	286[14.0 L	276 10.1 Ch	249 8.5 Bl	259 10.2 Bf	RS PEG
183308	296[13.5 L	296 9.4 Ch	255 8.3 Bl	T CEP	220714
158 7.0 Wb	297[12.0 Ch	302 8.7 Pt	WX CYG	210868	259 12.6 Bf
284 8.6 L	304[14.5 L	307 8.8 Sp	201437b	159 6.4 Wb	264 12.6 Bf
291 8.5 L	X LYR	NOV CYG	285 10.8 L	257 8.6 Go	270 12.5 Bf
300 8.5 L	190926	195553	292 10.3 L	259 8.8 Go	Z AQR
302 8.7 Pt	302 9.1 Pt	296[11.5 Ch	297 10.8 Ch	264 9.1 Ch	*221321*
R SCT	RU LYR	300[12.2 Pt	300 10.2 L	288 9.8 Sw	259 10.3 Bf
184205	190941	302[12.2 Pt	303 10.0 Pt	295 10.1 Pt	T GRU
284 5.4 L	302 12.8 Pt	Z CYG	U CYG	295 10.0 Fd	*221938*
288 5.8 Lg	U DRA	195849	201647	296 9.9 Ch	255 9.6 Sm
290 5.4 L	190967	296 8.5 Ch	174 9.9 Wb	300 9.7 Sw	265 8.7 En
292 6.1 Lg	296 9.3 Ch	302 8.4 Pt	301 10.0 Fd	301 10.1 Fd	273 8.9 En
295 6.0 Ch	302 9.5 Pt	SY AQL	302 8.8 Gb	302 10.0 Fd	S GRU
296 5.9 L	W AQL	200212	303 8.8 Pt	303 10.1 Fd	*221948*
297 5.8 Sp	*191007*	286 10.7 L	307 8.6 Sp	304 10.0 Fd	255 12.2 Sm
297 5.1 Pt	302 9.6 Pt	299 11.2 L	U MIC	318 10.3 Fd	259 12.2 Ht
299 5.6 L	T SGR	302 10.8 Pt	*202240*	322 10.1 Fd	265 12.2 En
300 5.8 Pt	*191017*	305 11.0 L	255 11.7 Bl	S MIC	266 12.0 Ht
301 5.8 Sp	302 12.0 Pt	S CYG	RW CYG	*212030*	266 12.2 Sm
302 5.8 Pt	R SGR	200357	202539	249 9.4 Bl	270 12.2 En
302 5.8 Gb	*191019*	303 14.2 Pt	309 9.1 Rt	255 9.7 Bl	S LAC
303 6.0 Pt	302 11.4 Pt	SV CYG	Z DEL	W CYG	222439
304 5.9 Pt	U LYR	200647	202817	213244	285 13.0 L
304 5.5 L	191637	309 8.8 Rt	303 9.1 Pt	278 6.0 L	296 12.2 L
304 5.8 Sp	302 9.3 Pt	S AQL	SZ CYG	284 6.4 L	300 12.7 L
307 6.0 Sp	RT AQL	200715a	202946	289 5.9 L	R IND
308 5.9 Pt	193311	303 10.8 Pt	293 8.8 Pt	295 6.0 L	*222867*
316 5.5 Bh	296 10.8 Ch	RW AQL	295 8.8 Pt	299 6.1 L	255[13.5 Bl
318 5.6 Sp	302 10.8 Pt	200715b	297 9.5 Pt	304 6.2 L	T TUC
NOV AQL	R CYG	303 9.5 Pt	300 9.2 Pt	305 6.2 L	*223462*
184300	193449	R TEL	301 9.5 Pt	S CEP	255[12.8 Sm
297 10.6 Ch	*276* 8.7 Ch	*200747*	302 9.5 Pt	213678	*266*[13.2 En
300 11.6 Pt	302 7.0 Pt	255[11.5 Bl	303 9.4 Pt	295 8.0 Pt	273[12.8 Ht
302 11.5 Pt	302 6.5 Gb	RS CYG	308 8.9 Pt	RV CYG	270[13.0 Dr
307 10.8 Sp	309 6.6 Rt	200938	310 8.9 Pt	213937	R LAC
308 11.5 Pt	RV AQL	174 7.2 Wb	ST CYG	278 6.8 L	223841
ST SGR	193509	*276* 9.0 Ch	202954	286 6.6 L	278 12.9 L
185512a	320 12.2 Pt	277 8.8 Ch	303 13.6 Pt	295 6.3 Pt	286 12.1 L
290[12.2 L	T PAV	285 8.2 L	V VUL	*296* 6.9 L	296 10.6 L
299[12.5 L	*193072*	292 8.2 L	203236	300 6.9 L	297 10.1 GC
304[13.5 L	247 8.3 Ht	295 8.8 Ch	303 9.1 Pt	R GRU	300 10.0 L
Z LYR	248 8.0 Bl	296 8.8 Ch	S DEL	*214247*	U LAC
185634	255 7.8 Bl	297 8.8 Ch	203816	255[12.9 Bl	224354
286 12.9 L	255 8.3 Sm	300 8.2 L	304 8.7 Pt	266[11.6 Sm	297 8.6 By
296 12.8 L	259 8.2 Ht	303 8.2 Pt	V CYG	RT PEG	RW PEG
300 11.8 L	266 8.2 Ht	305 8.4 L	203847	215934	225914
R AQL	266 8.5 Sm	R DEL	297[11.7 Ch	267 11.6 Ch	259 10.0 Bf
190108	276 8.6 Bl	201008	304 12.5 Pt	RZ PEG	264 9.5 Bf
296 11.1 Ch	RT CYG	286 11.0 L	RZ CYG	220133b	270 9.4 Bf
302 10.0 Pt	194048	299 11.1 L	204846	295 12.0 Pt	295 10.5 Pt
RW SGR	174 8.0 Wb	303 11.0 Pt	304 13.1 Pt	T PEG	V CAS
190819a	302 12.6 Pt	305 11.0 L	S IND	220412	230759
297 9.5 Ch			*204054*	286 12.0 L	295 11.1 Pt
			255[13.5 Bl		300 11.0 B

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1928.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
V CAS	V PHE	R AQR	Z CAS	V CET	R CAS
230759	*232746*	*233815*	233956	*235209*	235350
303 10.7 Sw	265[12.7 En	247 9.7 Ht	209[11.2 Eb	249 8.9 Bl	309[11.0 Eb
309 10.4 Kz	272[12.0 Dr	249 9.6 Bl	RS AND	255 8.9 Bl	Z PEG
309 10.4 Eb	Z AND	255 9.5 Bl	235048	276 10.2 Bl	235525
S PEG	232848	255 9.6 Sm	297 9.0 By	286 11.7 L	295 13.2 Pt
231508	267 10.2 Ch	259 9.7 Ht	RR CAS	R TUC	Y CAS
295 12.8 Pt	295 10.0 Pt	262 9.9 Bf	235053	*235265*	235855
V PHE	ST AND	266 9.8 Bf	298 13.4 Bn	257[12.9 Sm	309[11.0 Kz
232746	233335	266 9.5 Sm	309[14.1 Kz	265[12.9 En	SV AND
255[12.7 Sm	267 11.2 Ch	267 9.5 Ch	316[13.1 Bn	266[13.0 Sm	235939
259[13.2 Ht	295 10.6 Pt	276 9.2 Bl		270[12.9 En	295 12.5 Pt
	297 10.4 Lg				

RAPIDLY VARYING IRREGULAR VARIABLES.

Star J.D. Est.Obs	J.D. Est.Obs.	Star J.D. Est.Obs.	J.D. Est.Obs.
005840 RX ANDROMEDAE—		074922 U GEMINORUM—	
5295.6[11.7 Pt	5311.6[11.7 Pt	5255.4[13.7 Bf	5291.6 10.5 Lg
5297.6[12.4 Pt	5316.6 10.8 Pt	5259.1 14.6 Bf	5291.7 12.0 GC
5303.7 11.5 Pt		5264.1[12.3 Ch	5292.1 11.7 Ch
060547 SS AURIGAE—		5265.1[11.7 Ch	5292.3 11.7 L
5255.3[13.9 Bf	5297.2 11.0 Ch	5266.4 14.7 Bf	5292.5[11.9 GC
5259.1 15.2 Bf	5297.3 10.8 L	5267.1 14.6 Bf	5292.7 12.4 Lg
5261.1 15.2 Bf	5297.6 10.8 Pt	5268.1[12.4 Ch	5293.3 12.5 L
5264.0[11.6 Ch	5298 2 11.0 Ch	5269.1[12.3 Ch	5293.3 12.4 Gt
5264.1 14.9 Bf	5298.6 10.8 Lg	5270.2 14.4 Bf	5293.6 13.1 GC
5265.1[11.6 Ch	5298.6 10.9 Sp	5271.1[12.4 Ch	5295.1[12.4 Ch
5266.0[11.6 Ch	5299.3 10.7 L	5272.2[12.3 Ch	5295.3 13.6 L
5266.3 15.2 Bf	5300.3 10.9 L	5273.4 14.2 Bf	5295.7 13.5 Lg
5267.0[11.6 Ch	5300.6 11.0 Lg	5274.2[11.7 Ch	5296.3 13.7 L
5268.2[12.4 Ch	5301.3 10.9 L	5275.2[11.4 Ch	5296.5[13.7 GC
5269.1[11.6 Ch	5301.6 11.5 Pt	5276.2[10.9 Ch	5297.1[12.4 Ch
5270.0[11.6 Ch	5301.6 11.0 Sp	5278.4[13.3 L	5297.3 13.9 L
5270.1 14.9 Bf	5301.6 10.9 Lg	5279.1[10.1 Ch	5298.1[12.4 Ch
5271.0[11.6 Ch	5302.4 11.0 L	5282 7 9.6 GC	5298.6 13.9 Lg
5272.1 15.1 Bf	5302.6 10.8 Lg	5284.0 9.4 Ch	5298.6[13.8 GC
5272.1[11.6 Ch	5302.6 11.5 Sp	5284.3 9.3 Gt	5299.3 14.1 L
5273.2[11.6 Ch	5302.9 11.5 Pt	5284.4 9.4 Gt	5299.6[12.4 Bh
5274.2[11.6 Ch	5303.3 11.0 L	5284.4 9.4 L	5300.3 13.7 L
5275.2[11.6 Ch	5303.3 10.7 An	5285.4 9.4 L	5300.7 13.9 Lg
5278.2[12.0 L	5303.7 11.5 Pt	5285.4 9.2 An	5301.6 13.9 Lg
5280.3[12.4 L	5304.3 11.3 L	5286.1 9.5 An	5302.6 13.9 Lg
5284.2[13.9 L	5304.3 11.3 An	5286.3 9.7 L	5304.7 14.0 Lg
5286.6[12.4 L	5304.6 12.0 Pi	5286.6 9.7 GC	5305.7 14.0 Lg
5288.3[13.9 L	5304.6 12.4 Pt	5288.1 9.5 Ch	5306.8[12.0 Lg
5289.6[14.1 Lg	5305.3 11.9 L	5288.3 9.8 L	5310.6[13.3 Wl
5290.4 14.2 L	5305.6 12.0 Lg	5288.3 9.9 An	5311.6[11.5 Pt
5291.6[14.1 Lg	5305.6[12.0 Pt	5289.0 9.9 Ch	5312.5[12.4 Cl
5292.3 14.3 L	5306.6[12.4 Pt	5289.6 9.0 Lg	5314.6 13.8 Lg
5293.3 13.4 L	5307.6[12.5 B	5289.2 9.9 L	5313.7[11.7 Pt
5293.3 13.2 Gt	5309.7[11.2 Eb	5289.5 10.4 GC	5316.6[12.4 Pt
5293.3 13.2 An	5311.6[12.4 Pt	5290.3 10.3 Ch	5317.6[12.4 Bh
5294 2 11.7 Ch	5312.5[12.5 Cl	5290.4 10.7 L	5318.6[12.4 Bh
5294.3 11.9 L	5313.7[12.4 Pt	5290.4 10.3 An	5319.5[12.5 Cl
5295.2 11.1 L	5314.6[13.5 Lg	5291.1 11.1 Ch	
5295.2 11.3 Ch	5315.6[13.7 B	213843 SS CYGNI—	
5295.6 11.0 Pt	5316 6[13.0 Wl	5264.0 12.1 Ch	5270.2 8.8 Gt
5295.7 11.8 Lg	5316.6[12.6 Pt	5266.0 11.2 Ch	5274.0 8.8 Ch
5296.2 11.3 Ch	5318.6[13.0 Bh	5267.0 8.8 Ch	5276.0 8.9 Ch
5296.7 11.4 Lg	5319.5[12.5 Cl	5268.0 8.7 Ch	5277.0 8.9 Ch
5297.1 11.1 Lg	5321.6[12.4 Pi	5270.0 8.7 Ch	5277.2 8.9 An

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1928.

RAPIDLY VARYING IRREGULAR VARIABLES.

Star	J.D.	Est.	Obs	J.D.	Est.	Obs.	Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
213843 SS CYGNI—							213843 SS CYGNI—						
	5277.2	9.0	Gt	5286.3	12.0	L		5296.3	12.1	L	5302.2	12.0	L
	5278.3	9.3	L	5289.2	12.0	L		5296.5	12.0	GC	5302.9	11.7	Pt
	5278.5	9.4	By	5290.3	12.0	L		5297.3	12.1	L	5303.3	12.0	L
	5279.0	9.7	Ch	5291.7	12.0	L		5297.5	12.1	GC	5303.9	11.7	Pt
	5280.3	9.7	L	5292.7	11.4	L		5297.6	11.7	Pt	5304.3	11.8	L
	5284.2	12.0	L	5293.2	11.6	L		5298.5	12.0	GC	5304.9	11.8	Pt
	5284.2	12.0	Gt	5293.2	11.6	Gt		5299.3	11.8	L	5305.5	11.7	L
	5285.2	12.0	L	5295.2	12.1	L		5300.3	12.1	L	5308.9	11.7	Pt
	5285.3	12.0	Gt	5295.6	11.7	Pt		5300.9	11.7	Pt			

MONTHLY SUMMARY.

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Allen, P. R.	Al	6	8	Kohl	Kl	3	11
Ancarani	An	13	42	Kurtz	Kz	16	16
Baldwin	Bl	53	122	Lacchini	L	68	337
Bappu	Bf	29	84	Lee	Lh	4	4
Barry	By	24	69	Logan	Lg	36	71
Bouton	B	59	75	Marshall	Mh	7	7
Brown, A. N.	Bn	3	10	Peltier	Pt	176	258
Bunch	Bh	10	14	Pickering	Pi	25	29
Chandra	Ch	95	205	Prentice	Pn	3	3
Clement	Cl	4	5	Rittenberg	Rt	15	20
Dartayet	Dr	25	118	Smith, F. W.	Sf	6	8
Ebert	Eb	16	16	Smith, W. H.	Sm	25	118
Ensor	En	35	62	Spears	Sp	18	36
Ford	Fd	22	87	Swanson	Sw	8	10
Gaebler	Gb	5	5	Waldo	Wl	20	20
Giustino	Gt	8	29	Webb	Wd	3	11
Gomi	Go	8	25	White	Wb	13	21
Goodsell	Gs	2	2	Georgetown	GC	21	34
Houghton	Ht	29	82	Coll. Obs.	—	—	—
Jones	Jo	9	15	Totals	38	348	2036

ERRATA IN MONTHLY REPORTS FOR 1926-27 (REPRINTS).

1926

p. 4* *043562* R Dor 4435.4, *for* Bl *read* Sm
4 *055686* R Oct *for* 4444.0 *read* 4414.0
12 *212814* Y Cap 4413.1, *for* 10 8 *read* [12.8
16 *000339* V Scl 4449.0, *for* [13.0 *read* [13.3
22 *185437a* S CrA *for* Borealis *read* Australis
31 *154331* S Col 4460.0, *for* 13.1 *read* [13.1
45 *063462* Nov. Pic 4505.1, *for* 4.6 *read* 4.7
46 *101153* W Vel 4497.0, *for* 9.1 *read* 9.0
56 *092551* Y Vel *for* Vulpeculae *read* Velorum
60 *193972* T Pav *for* TS *read* T
64 *005475* U Tuc *for* Y *read* U
65 *005022* T Lep 4557.0, *for* 7.6 *read* 8.6
80 *104620* V Hya 4576.0, 4582.0 and 4589.1 *for* B *read* Bl
92 014958 X Cas 4584.4, 4590.5 and 4621.5, *for* 11.2, 11.1 and 11.3 *read* 12.3, 12,1 and 12.3
94 *074241* W Pup 4663.2, *for* 11.8 *read* 11.7
102 *191033* RY Sgr 4648.4, *for* Bl *read* Ht
110 *092551* Y Vel 4707.9, *for* [13.0 *read* 13.0
114 *182133* RV Sgr *for* 4798.0 *read* 4698.0
122 014958 X Cas 4799.4, *for* 13.7 *read* 12.4

*Pagination is that of the Reprints.

1927
p. 2 *010630* U Scl 788, *for* 10.1 *read* 10.8
3 *095563* RV Car *for* 785 *read* 789
3 *104620* V Hya *for* W *read* V
3 *122854* U Cen 768, *for* 7.6 *read* 8.6
4 *145971* S Aps 768, *for* 10.4 *read* 10.0
4 *151822* RS Lib 787, *for* 10.4 *read* 10.0
4 *160021* Z Sco 789, *for* 9.9 *read* 10.0
5 *162816* S Oph 780, *for* Bl *read* B
5 *174135* SV Sco 769, *for* 10.4 *read* 10.0
6 *191033* RY Sgr 794, 6.3, *for* Bl *read* Pt
7 *214247* R Gru 777, *for* 10.1 *read* 10.7
10 *043263* R Ret 813, *for* 12.5 *read* 12.7
10 *044349* R Pic 813, *for* 8.3 *read* 7.3
11 *104620* V Hya *for* W *read* V
12 *152849* R Nor *for* X Lib *read* R Nor
28 *185437a* S CrA 851, *for* 12.0 *read* [12.5
33 *000339* V Scl *for* 908 *read* 904
35 *082476* R Cha 907, *for* [13.2 *read* 13.2
41 *050848* S Pic 940, *for* Bl *read* Sm
41 *151247* T Pic 933, *for* Ht *read* Bl
43 *092551* Y Vel 915, *for* 11.3 *read* 11.0
44 *132422* R Hya *for* W *read* R
44 *133155* RV Cen 915, *for* 7.2 *read* 7.5
53 *104620* V Hya 967, *for* 8.5 *read* 8.4
55 *145971* S Aps 954 10.1 Bl *omit*
62 014958 X Cas *for* 008 *read* 088
62 *043562* R Dor 058, *for* 6.2 *read* 6.3
66 *151822* RS Lib 029, *for* 10.9 *read* 10.8
77 *164844* RS Sco 181, *for* 181 *read* 081

servatory, Poughkeepsie, N. Y., on Saturday, June 2. It is hoped that many of our members will be present, especially those from New York and vicinity. President Pickering and Council-Member Elmer will represent the Association at the July meeting of the International Astronomical Union at Leiden, Holland.

LEON CAMPBELL, Recording Secretary.

April 7, 1928.

COMET NOTES.

By G. VAN BIESBROECK.

COMET 1928 *b* (GIACOBINI). The second new comet of this year was found at the Paris Observatory by the veteran discoverer M. Giacobini. The details are given in the following telegram:

Comet Giacobini 1928 Mar. 17 at $22^h\ 14^m$ U.T.
$\alpha = 5^h\ 50^m0 \qquad \delta = +14^\circ\ 35'$
Magnitude 11. Motion rapidly southward.

It was further learned that this was a visual observation under unfavorable conditions, the comet having been seen only for a few minutes. Through an unexplainable circumstance the announcement was not broadcast until March 24 and during this week's interval the moon had come near the presumed position of the comet, so that it is not surprising that nobody succeeded in locating it.

However, on April 13 the following observation obtained by Mineur at Paris, was broadcast:

March 28.9585 $6^h\ 12^m\ 26^s.5$ $+14°\ 57'\ 39''$ (apparent place)
Magnitude 10. Daily motion $+3^m\ 16^s$ and $0'$

This time the delay in transmitting the position was more than two weeks, so that the information was almost worthless after such a long interval. Nothing further has been heard about this comet, which must now be considered as lost. At the Yerkes Observatory a search was made on April 14 by Mr. Y. C. Chang and the writer, both visually and photographically, but nothing was found although large areas were examined. It is very doubtful if the observation of March 28 refers to the object announced by Giacobini, since its motion seems quite different from that given by the discoverer.

It seems hard to understand why the Paris observers have ignored the use of the simple telegraphic system by which all observatories are at once notified of discoveries. The delay in transmitting the data in this case was such that it was practically impossible for other observers to find the new object. This is the more surprising when we remember the splendid cometary record of M. Giacobini. While at the Nice Observatory, in the clear skies of the French Riviera he found no less than twelve unexpected comets between 1896 and 1907. In 1909 he became a member of the staff of the Paris Observatory, and his chances for comet-hunting were naturally much reduced in the center of a great metropolis. This thirteenth comet found by him now shows what an enthusiastic observer will do under the most unfavorable circumstances.

Except for this vainly looked for elusive visitor, the cometary season is quieting down. The two comets now under observation are gradually fading.

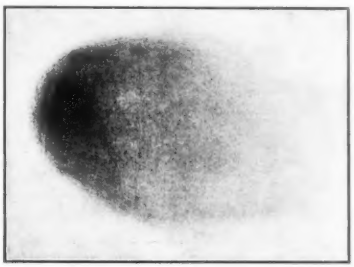

FIGURE 1.

In its fourteenth month of visibility COMET 1927 *d* (STEARNS) appears as illustrated in Figure 1. The nucleus is not very sharp; the coma extends to a distance of 1½′ from it, mainly in position angle 80°, making a broad fanlike tail. The total brightness is, however, hardly more than 14^M. Y. C. Chang has computed a new set of elements from three normal places covering an interval of ten months. His orbit comes out elliptic, but it differs only slightly from a parabola ($e = 0.999157$) showing that the period runs into centuries. He has computed the following ephemeris which will probably carry the object to the end of its period of visibility. It is very well placed for northern observatories, but is only in reach of large instruments.

EPHEMERIS OF COMET 1927 *d* (STEARNS).

0h U.T.		1928.0		Mag.
		h m	° ′	
May	1	17 36.1	+63 9	14.1
	9	30.4	64 38	
	17	23.0	65 53	
	25	14.2	66 54	
June	2	17 4.5	67 40	14.3
	10	16 54.2	68 10	
	18	44.1	68 25	
	26	33.6	68 26	
July	4	26.2	68 16	14.5
	12	19.3	67 54	
	20	14.2	67 24	
	28	10.8	66 48	
Aug.	5	9.2	66 6	14.6
	13	9.3	65 22	
	21	11.0	64 35	
	29	14.1	63 48	
Sept.	6	16 18.6	+63 1	14.7

Further measures have been made of COMET 1928 *a* (REINMUTH) in various observatories, but it is decreasing rapidly in brightness. When last observed here (April 18) I recorded it as a round nebulosity some 30″ in diameter with a faint central condensation; the total light was not brighter than that of a 15M star.

In order to check the suspected identity (see p. 159) of this comet with Taylor's comet (1916 I) Y. C. Chang computed the perturbations during its previous revolution around the sun. The comet stayed far from all planets and its orbit could not possibly have changed by as much as the identity would require. The same computer also roughly estimated the perturbations of comet Taylor during its approach to Jupiter in 1925 and found that the elements were not altered in the right direction for making them identical with those of 1928 *a*. This double proof shows conclusively that the two periodic comets are independent.

Williams Bay, Wis., April 23, 1928.

METEOR NOTES.

By CHARLES P. OLIVIER.

The following communication has been received from Dr. Issei Yamamoto of Kyoto University Observatory, Japan, with the request that it be announced to our members.

"From a consideration of Crommelin's revised elements of the Skjellerup daylight comet, I found recently that the comet had passed very close to the earth's orbit in its descending nodal passage. The closest distance was on January 22, and it was about 0.03 A.U. This year the earth will pass this region on June 6, and consequently a meteoric display may be expected. My preliminary computation of the radiant point is: R.A. 42°; Decl. +41° (for apparent radiant).

"The interval of the meteoric shower will be brief, because of the high inclination of the orbit. But the recent close approach of the swarm to the sun might have acted on it so as to scatter the members somewhat. The full moon may interfere . . . "

As such close approaches to orbits of comets are not frequent, it is hoped that all meteor observers will be on the lookout during the interval June 5 to 7 for a possible shower. Remember, if one does appear, that the things most necessary to do are (1) plot enough meteors to determine accurately the radiant, (2) to determine the rate per hour. Let all observers have their maps and blanks ready so as not to be caught unprepared.

Since publication of our annual report for 1927, the observations of I. L. Thomsen, of Danneviske, New Zealand, have come in. These were made on May 6, July 20, August 2 and 6, and October 19. As he was short of maps, he measured off the coördinates of the meteors and so reported them. The writer has not yet had time to re-plot these and determine the radiants. His total was 72 meteors for the five nights.

R. A. McIntosh of Auckland, New Zealand, has sent in observations made in 1928 as follows: February 19, 21, and 26; March 20, 22, and 23; also a few casuals; total 70 meteors. As the writer is slow about announcing the exact position of radiants until he has given the maps a thorough study, he only cares to announce here that several good radiants are shown on these maps by preliminary inspection. Both of these observers worked long enough on each night mentioned to secure data as to rates as well as positions of radiants.

These two active members in the Southern Hemisphere are adding a most valuable contribution to the work of the A.M.S., as the radiants in the far southern sky are as yet practically unknown. Their work will be simplified from now on since we can furnish gnomonic maps for that part of the sky in any number wanted.

As the writer has recently been appointed professor of astronomy and director of the Flower Observatory, University of Pennsylvania, the headquarters of the American Meteor Society will be moved to that observatory on September 1, 1928. This early notice is given as the writer may be absent from the University of Virginia during part of the summer, therefore all requisitions for maps, etc., that may be needed between June 15 and August 15, 1928, should be sent in by June 1. A further notice relative to this will appear in the June-July "Meteor Notes."

Leander McCormick Observatory, University of Virginia, 1928 April 20.

COMMUNICATIONS.

Elementary Astronomy in High School.—The Penta Club of Central High School, Ft. Worth, is an honor organization of the Senior Mathematics Class, whose sole aim is the study of elementary astronomy. Regular meetings are held on Wednesday afternoons after school at which time some astronomical topic is studied and discussed. Field meetings are held on Friday evenings when the weather permits, when constellation drill is conducted by one of the more advanced members and various objects of interest are identified and discussed.

The Pentas have recently purchased a 4⅛-inch refractor for class use and club enthusiasm has received a new impetus. The glass was purchased with funds raised by the club members themselves, parties and class plays being the methods used. Last year the activities of the club were carried on through the vacation months and the idea was such a success that the same thing is planned for the coming summer.

In her work with this group of young people, Miss Charlie M. Noble, mathematics teacher at Central High School, and sponsor of the Club, has demonstrated the value of elementary astronomy as a high school subject. But more than this, she has solved the problems of social affairs and entertainment for the class by directing most of their efforts along these lines into one channel and has as a crystallized result wholesome entertainment of a highly educational nature. And not one parent of a Penta need ask himself where his son or daughter is during a Penta meeting. Mothers, fathers, and teachers elsewhere might follow Miss Noble's example with profit to themselves and to their young people.

STERLING BUNCH.

Box 86, Stockyards Station, Ft. Worth, Texas.

Meteor Observation.—On the evening of April 10 at 7:41, Eastern Standard Time, I viewed a meteor which started at a point between η Leonis and Regulus, and passed in a straight line through Cancer in a northwest direction just above Praesepe to a point a very little east of Castor and Pollux. Along the central part of its path it had a color and magnitude equal to the star Procyon. The observed time was about three seconds, and the train was white instead of the usual red color.

H. WEBB.

9251 173rd St., Jamaica, L. I., N. Y., April 12, 1928.

GENERAL NOTES.

Dr. Harlow Shapley has received a grant from the Milton Fund for Research for use in continuing his studies on variable stars and the dimensions of the Galaxy. (*Science*, April 6, 1928.)

Mr. E. W. Maunder, for many years Superintendent of the Solar Department of the Royal Observatory, Greenwich, died on March 21, at the age of seventy-six years. (*Nature*, March 31, 1928.)

Dr. Charles P. Olivier, of the Leander McCormick Observatory, University of Virginia, has been elected to the Wall Flower Professorship of Astronomy at the University of Pennsylvania and to the directorship of the Flower Observatory.

Dr. Ernest W. Brown, Sterling professor of mathematics at Yale University, has been elected to membership in the Royal Academy of Science of Belgium, "because of his eminent contributions to the science of mathematics." (*Science*, April 6, 1928.)

Professor Max Wolf.—We have just learned with much regret that Professor Max Wolf, Director of the Observatory of the University of Heidelberg on the Koenigstuhl, has been seriously ill with typhoid fever during the winter. He has fortunately now so far recovered as to be able to resume his important work. In spite of the long number of years of his past activity the records tell us that he will not reach his sixty-fifth birthday until the 21st day of June of the

present year. His many friends will wish him a full return of strength to carry on his investigations for many years to come.

Dr. R. A. Millikan, director of the Norman Bridge laboratory of physics of the California Institute of Technology, gave one of the Proctor Foundation lectures at the Brooklyn Institute of Arts and Sciences on April 5. His subject was "Recent Advances in Spectroscopy." (*Science,* April 6, 1928.)

Professor A. S. Eddington, F.R.S., Plumian professor of astronomy at the University of Cambridge, has accepted an invitation to deliver the Adamson memorial lecture. His subject will be "Philosophical Tendencies in Modern Science," and the lecture will be delivered in the university on May 4. (*Science,* April 6, 1928.)

A Request. — In the November (1927) issue and again in the March issue we sent out a call in a note similar to this one for copies of certain of the issues in 1927 of which our files were practically depleted. The call was met with a number of responses and, while not a very large number of copies were secured, we now have on hand several copies of each of them. We are now desirous of securing copies of the January, February, March, and April issues of Volume 28 (1920). An observatory in Germany is so eager to secure them that it has offered to purchase the entire volume, if necessary. Anyone having this complete volume or any of the single copies mentioned and who is willing to dispose of them will confer a great favor upon our purchaser by communicating with us. Incidentally, we are prepared to pay a good price for them.

Guggenheim Foundation Fellowships.—Fellowships, amounting to the rather large sum of $173,000 in the total, have recently been awarded by the John Simon Guggenheim Memorial Foundation to seventy-five young American scholars, scientists, and artists. Two of these fellowships are for astronomical research exclusively. One was awarded to Dr. W. J. Luyten, of Harvard University, who will carry out a program of photographing the southern sky from the Harvard Station at Mazelspoort, South Africa. The other was awarded to Dr. Otto Struve, of the Yerkes Observatory, who with Professor A. S. Eddington at Cambridge University, England, will make a theoretical study of the distribution and physical properties of diffuse matter in interstellar space. (*Science,* March 30, 1928.)

A Revival of Hydrogen Rays in f^1 Cygni.—Probably no fable associated with the stars is better known that the story of Pleione the lost Pleiad. This star now invisible to most eyes seems to have been easily visible in the past. But Pleione has suffered another loss quite as incomprehensible to astronomers in that a brilliant series of hydrogen emission lines which characterized it conspicuously in the past is now totally lacking. These lines faded out before our eyes. Two other stars, μ Centauri and f^1 Cygni, and possibly a few others have lost bright hydrogen lines in the same way.

Professor R. H. Curtiss has called attention to the disappearance of hydrogen emission lines in the spectrum of f^1 Cygni. They were brilliant in 1895, vanishing in 1912, absent in 1918. But soon after 1920 there were indications of impending revival of bright hydrogen and late in 1927 well recorded hydrogen emission was

observed again and reported by Dr. Curtiss in a recent number of the *Monthly Notices of the Royal Astronomical Society.*

Renewed watch will now be kept on the spectrum of Pleione for the return of its lost emission. Professor Curtiss remarks that it is probable that the composition or extent of the atmosphere of Pleione and f[1] Cygni did not change, unless by some great pulsation, and that it is more probable that some type of excitation coming from the star's effective photosphere provided the variable factor.

Zodiacal Light Observations.

Interesting series of reports have been received from Miss Rebecca Jones, assistant at the Lick Observatory; Professor Leah B. Allen, Williams Observatory, Hood College, Frederick, Md.; and Mr. Oscar E. Monnig, Ft. Worth, Texas. A digest of all reports will be made for the next issue of POPULAR ASTRONOMY. Contacts are being sought in Java, South Africa, New Zealand, and Scotland. Observers, especially Geo. Jones, report that north of the equator the greater area of Zodiacal Light illumination is north of the ecliptic; south of the equator the greater area is seen south of the ecliptic. This is an important feature of the problem. Is the material which reflects the light south of the equator the same material as that which reflects the light on the same evening or morning north of the equator? For reference, a bibliography is being assembled. The courtesy of Captain C. S. Freeman, U.S.N., Superintendent of the U. S. Naval Observatory, and of Dr. W. J. Fisher, Harvard College Observatory, in making possible this compilation, is hereby acknowledged.

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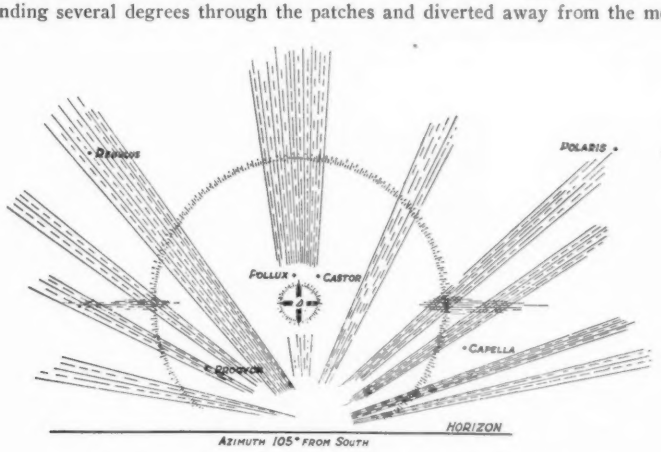
W. E. GLANVILLE.

The Rectory, New Market, Maryland.

The Aurora of March 28, 1928.— The peculiar combination of an aurora with a lunar halo as visible in Cambridge on the night of March 28 is such an unusual occurrence that the event seems deserving of more than passing mention.

The lunar halo first attracted my attention about 11:00 P.M., Eastern Standard Time. A few minutes later the halo bore a fringe strikingly suggestive of a solar corona. By 11:30 a well-defined auroral fan was centered at a point on the horizon directly under the moon (at first quarter) with a streamer extending from the horizon directly past the moon and vertically upward. Oblique streamers arranged themselves approximately symmetrically about this line. One of these passed above Capella and at 11:50 P.M. extended across Polaris, and between Vega and Hercules to the eastern horizon.

A similar brilliant streamer mounting from the auroral center extended southward passing Procyon and Regulus in Leo. These two streamers crossed the lunar halo very nearly on the same circle of altitude as the moon and the crossing points were marked by exceptionally brilliant patches of auroral light. The outstanding feature of the phenomenon was the existence of horizontal streamers extending several degrees through the patches and diverted away from the moon



COMPOSITE SKETCH OF AURORA OF MARCH 28-29, 1928.
MARCH 29, 4^h-6^h, G.C.T.

as an apparent radiant point. These horizontal streamers with an apparent radiant at the center of the halo made angles of 20°-30° with the long auroral streamers but gave every appearance of a true auroral effect. The distance of one of the bright patches from the moon was observed with a sextant and found to be 25°, thus fixing the radius of the lunar halo. The large halo vanished at 11:50 P.M. whereupon a smaller ring of 4° radius appeared about the moon. This in turn vanished at midnight. At 12:10 A.M. the large 25° halo returned for about five minutes and at 12:20 A.M. a symmetrical cross with horizontal and vertical beams appeared across the moon's disk. Shortly after 1:00 A.M. light cirro-stratus had developed and the aurora faded. The temperature was 30° F. There had been a fall of 33° F since the day previous.

The combination of the optical effects in an all but invisible cirro-stratus with a true auroral glow gave a suggestion of the problem encountered in a study of the solar corona, where we may very well have light from electrical excitation mixed with an optical corona formed from minute particles comprising a circulating circumsolar cloud.

The effect of the auroral streamers at presumably an altitude of four or five hundred miles, combined with optical phenomena in a layer of cirrus at an altitude of four or five miles gives one food for thought.

On examining our sunspot photograms the following day a spot of marked intensity passed within 5° of the sun-earth line at midnight, Eastern Standard Time, March 28-29. The field strength of WBBM as measured on the automatic radio recorder 9-10 P.M., March 28, was exceptionally low and the static heavy.

H. T. STETSON.

Astronomical Laboratory, Harvard University.

Hydrogen Satellites.—There are perhaps no stars in the sky which have been given more attention as individuals by spectroscopists than the helium stars which are characterized by visible emission rays of hydrogen. Back in Civil War days, Father Secchi found the two best known stars of this group in γ Cassiopeiae and β Lyrae, and was so impressed by their peculiarities that he created for them a special spectral type numbered five. Though this fifth type did not survive and was replaced by Pickering's type of the same number, the hydrogen emission stars continued to command the attention of a succession of illustrious spectroscopists including Huggins, Vogel, Scheiner, Von Gothard, Pickering, Lockyer, McClean, Keeler, Campbell, Frost, Wilsing, Belopolsky, Sidgreaves, and many recent investigators. In a study of β Lyrae twenty years ago Professor R. H. Curtiss pointed out a new fact that bids fair to prove important in its bearing on the mystery of these stars. This is that the absorption borders which commonly flank the hydrogen bright rays are made up of several narrow components and that these dark satellite lines are about equally spaced on either side of a central point and that the scale of this symmetrical spacing is the same for all of the hydrogen lines studied where the unit of measurement is velocities in kilometers per second.

A few years later Professor Curtiss found a similar group of dark satellite lines with identical spacing, within the limits of error of measurement, bordering the bright lines of hydrogen in the spectrum of γ Cassiopeiae. No other investigator reported observation of these new features. In a recent number of the *Monthly Notices of the Royal Astronomical Society*, Dr. J. S. Plaskett announced the detection and measurements of several dark hydrogen satellites in the spectrum of the bright star υ Sagittarii. In the last (January) number of this magazine Dr. Curtiss pointed out the striking correspondence of these new satellites with those of β Lyrae and γ Cassiopeiae and the probability that still others would be found. Miss Frances Seydel, a student at the University of Michigan Observatory, has found on the Ann Arbor spectrograms of υ Sagittarii the predicted satellites that complete the correspondence of these features with those of β Lyrae and γ Cassiopeiae.

Professor Curtiss points out that these dark satellites bordering hydrogen emission lines may be regarded as alternations of emission and absorption. He remarks that whatever condition is responsible for these dark borders is apparently

symmetrically variable at regular intervals measured vertically in the star's atmosphere. Thus, if this condition is one of atmospheric density it would seem that the vertical density gradient in the hydrogen atmosphere changes abruptly at levels definitely spaced. Stationary nodal points in a pulsating atmosphere might account for such gradient changes. Whether such be possible or not it is apparent that some great oscillation or periodic surging, whether of matter or of energy, in these hydrogen atmospheres is producing a cyclic redistribution of emission in the lines of the ϕ Persei variables, which are stars belonging to this bright line group.

Life and the Universe.—Remarks on this topic are of interest to all thoughtful persons. While it is true that comment upon so baffling a question is largely in the nature of speculation, Professor J. H. Jeans has studied the related questions so carefully that he is one of a very few whose words deserve and receive more than ordinary attention. Professor Jeans concluded his lecture on "The Wider Aspects of Cosmogony," delivered before the Royal Society of Arts, on March 7, under the above title. In his lecture he shows that if the earth, the cradle of humanity, be regarded as seventy years old, then humanity itself is a mere babe three days old, not yet by any means fully aware of the extent and meaning of the universe in which it finds itself. The entire address, published in the *Supplement to Nature*, March 24, 1928, is packed with new ideas which are astonishing when met for the first time. The concluding paragraphs are copied here.

> The planets are the only places we know where life can exist. The stars are too hot; even their atoms are broken up by the intense heat. Nebulae are in every way unsuitable; even if cool solid bodies exist in them, they would probably be so drenched with highly penetrating radiation as to render life impossible. Life demands a special type of matter, such as does not produce intense light and heat by transforming itself into radiation. We find it only in the surfaces of the stars, which are too hot for life, and in the planets which have been pulled out of these surfaces.
>
> On any scheme of cosmogony, life must be limited to an exceedingly small corner of the universe. To our baby's wonderings whether other cradles and other babies exist, the answer appears to be that there can at best be very few cradles, and there is no conceivable means of knowing whether they are tenanted by babies or not. We look out and see a universe consisting primarily of matter which is transforming itself into radiation, and producing so much heat, light, and highly penetrating radiation as to make life impossible. In rare instances, special accidents may produce bodies such as our earth, formed of a special cool ash which no longer produces radiation, and here life may be possible. But it does not at present look as though Nature had designed the universe primarily for life; the normal star and the normal nebula have nothing to do with life except making it impossible. Life is the end of a chain of by-products; it seems to be the accident, and torrential deluges of life-destroying radiation the essential.
>
> There is a temptation to base wide-reaching inferences on the fact that the universe as a whole is apparently antagonistic to life. Other quite different inferences might be based on the fact of our earth being singularly well-adapted to life. We shall, I think, do well to avoid both. Each oak in a forest produces many thousands of acorns, of which only one succeeds in germinating and becoming an oak. The successful acorn, contemplating myriads of acorns lying crushed, rotten, or dead on the ground, might argue that the forest must be inimical to the growth of oaks, or might reason that nothing but the intervention of a special providence could account for its own success in the face of so many failures. We must beware of both types of hasty inference.
>
> In any case, our three-days-old infant cannot be very confident of any

interpretation it puts on a universe which it only discovered a minute or two ago. We have said that it has seventy years of life before it, but in truth its expectation of life would seem to be nearer to 70,000 years. It may be puzzled, distressed, and often irritated at the apparent meaninglessness and incomprehensibility of the world to which it has suddenly wakened up. But it is still very young; it might travel half the world over before finding another baby as young and inexperienced as itself. It has before it time enough and to spare in which it may understand everything. Sooner or later the pieces of the puzzle must begin to fit together, although it may reasonably be doubted whether the whole picture can ever be comprehensible to one small, and apparently quite insignificant, part of the picture. And ever the old question obtrudes itself as to whether the infant has any means of knowing that it is not dreaming all the time. The picture it sees may be merely a creation of its own mind, in which nothing really exists except itself; the universe which we study with such care may be a dream, and we brain-cells in the mind of the dreamer.

BOOK REVIEWS.

Contributions From the Mount Wilson Observatory.— Four new numbers in this series have recently been received. They are:

No. 339. On the Relations between Period, Luminosity, and Spectrum among Cepheids, by Henry Norris Russell.

No. 340. On the Radial Velocity and Spectrum of the Cepheid Variable T Monocerotis, by Roscoe F. Sanford.

No. 341. Related Lines in the Spectra of the Elements of the Iron Group, by Henry Norris Russell.

No. 343. Secondary Standards of Wave-Length; Interferometer Measurements of Iron and Neon Lines, by Harold D. Babcock.

Photo-electric Photometry of Stars.—This is the title of Volume XV, Parts 1 and 2, of the *Publications of the Washburn Observatory*, of the University of Wisconsin. This account contains the results of the development of this phase of astronomical research at the hands of Professor Joel Stebbins, and his colleagues, at the University of Illinois and at the University of Wisconsin, during the years 1916-26. The instruments and methods are presented by illustrations and description. The details of observations and deductions from the observations of several stars are given. A chapter devoted to "General Remarks" is interesting and illuminating in that it gives clearly and succinctly, the author's judgment of the foundation principles of his method after years of experience. One almost insurmountable objection to the method is, he says, the fact that the unknown star and the comparison star must be observed consecutively rather than simultaneously. He says also that the *permanency* of the record which the photographic plate affords is an advantage in favor of photographic photometry. However, Professor Stebbins has seen the photo-electric method, in his own work, increase three hundred thousand times in sensitivity, which denotes marked progress. With humility characteristic of and becoming the true scientist, he attributes this advancement to the crude beginnings rather than to the refinement attained.

Part 2 is devoted to the results of the study of the four variable stars, 21 Cassiopeiae, 9 Andromedae, T Vulpeculae, and H.R. 8084, by Charles Morse Huffer, by this method at the Washburn Observatory.

Lick Observatory Bulletin, No. 397, recently issued, contains material supplementary to *L.O.B.*, **11**, 41, 1923, relating to the Wm. H. Crocker Eclipse Expedition for observing the total solar eclipse of September 21, 1922, at Wallal, Western Australia. This Bulletin of thirty pages gives details by Dr. R. J. Trumpler of the results secured with the twin camera of five feet focal length with two wide-angle quadruplet objectives of four inches aperture. For our readers who may not have access to the original, the conclusions are reprinted here.

1. Six photographs of the star field surrounding the eclipsed Sun were obtained with the five-foot cameras, and four of these contain also an exposure of a check star field.

2. The eclipse plates were compared by differential measurement with photographs of the same stars taken at Tahiti four months before the eclipse.

3. On every plate the stars near the eclipsed Sun appear displaced away from the Sun's center as compared with the reference stars situated in the outer portions of the plate, and the observations of this instrument lead to a value of $1''.82 \pm .''15$ for the light deflection at the Sun's limb. The check field stars show no such displacements.

4. Although the two series of observations made at the 1922 eclipse differ in the type of instrument used as well as in the methods of measuring and reduction, their results are in the best agreement.

5. Combining the measures of the two instruments, the relative displacements of stars between $0.^{\circ}5$ and 10° from the Sun's center are established with a high degree of accuracy (Table II) independently of any theoretical assumptions.

6. Within the limits set by the unavoidable errors of observation the star displacements are directed radially away from the Sun's center.

7. Einstein's law that the light deflections are inversely proportional to the angular distance from the Sun's center represents the observations best. With this law the combined observations of the two instruments furnish a value of $1''.75 \pm .''09$ for the deflection at the Sun's limb which agrees exactly with Einstein's prediction.

8. The eclipse observations contradict the existence of Courvoisier's "yearly refraction" at least in the immediate neighborhood of the Sun.

9. Abnormal refraction in the Earth's atmosphere caused by the cooling effects of the Moon's shadow could not have affected these measures appreciably.

An Outline of Stellar Astronomy. — Peter Doig, F. R. A. S. (The Draughtsman Pub. Co., London, Oct. 1927, pp. 162 + appendices. $2.00.)

The publishers say that the author has dealt with his subject "with a minimum of technical detail compatible with clear and adequate presentation," which is a very accurate statement.

The book is divided into three general sections. In Part I, "The Individual Star-Observational Data," the author discusses such subjects as dimensions, luminosities, numbers, distribution, and variability. In Part II he deals with "The Nature of a Star,"—its surface, interior, variability, and evolution. In Part III. under the title, "The Stellar Universe," he discusses the positions, distribution, and distances of the stars, nebulae, and clusters with reference to the galactic plane, both within and beyond the limits of the galactic system.

The author has drawn from his own published works, and from those of such men as Eddington, Hale, Hubble, Jeans, Kapteyn, Lundmark, Russell, Seares,

and Shapley. A feature which facilitates further study in any subject is a list of references at the end of each chapter.

Some of the more technical astrophysical terms such as the Compton effect, the relativity shift in spectral lines, and modern methods in parallax determination are well explained in the appendices.

The general reader will find in this book both a clear, concise statement of principles, supplemented by illustrations and tables, and a convenient bibliography to aid in further reading. M. M. H.

"Modern Astronomy," by Hector MacPherson, F.R.A.S. (Oxford University Press, London: Humphrey Milford. 190 pages.)

"Modern Astronomy—Its Rise and Progress" reminds one a good deal of Miss Clerke brought up to date. The author says that the birthday of the modern science of astronomy "was the 23rd of May, 1543, when Copernicus received on his death-bed an advance copy of his *magnum opus*—the volume which was to revolutionize human thought—*De Revolutionibus Orbium Coelestium.*" He carries us through the intervening four centuries down to the cosmological theories of Shapley, Russell, and Jeans, and Eddington's work on the internal constitution of the stars.

The book is written in a popular style for the layman, all mathematical and technical discussion being omitted. Of course, in 190 pages one can expect to find no more than an outline, and the author has succeeded well in giving facts with few words.

There are 25 illustrations of some interesting celestial objects, and noted astronomers. A convenient bibliography of the principal English books dealing with various aspects of astronomy is appended. M. M. H.

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SUBSCRIPTION PRICE.—The price of Popular Astronomy to subscribers living in the United States, or in a country to which the special rate of postage is applicable, is $4.00 per volume, of ten numbers; in Canada, $4.25; to all others, $4.50; in each case payable strictly in advance. Checks or Postal Money Orders should be made payable to Popular Astronomy.

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REPRINTS of articles, when desired, will be furnished to authors at the actual cost involved. Those wanting reprints should order them when the manuscript is sent to the editor. They cannot be furnished later without incurring much greater expense.

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CURVIN H. GINGRICH, *Editor* EDWARD A. FATH, *Associate Editor*